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BRIEFLY TOLD.

THIRD ANNUAL MEETING OF THE AMERICAN GAS INSTITUTE.—For quite some time back it was a fact patent to those concerned with the preliminaries of the third annual meeting of the American Gas Institute that the sessions would be notable for a large attendance; but we venture to say that the estimates of none were up to that registered and recorded. Every condition was favorable to this happening. New York in October, when October's moods are mild, is certainly a pleasant place for the visitor and the motive alike, and although Wednesday was ushered in with a brisk northeast breeze, and the morning air was suggestively sharp, yet as the day wore on the conditions changed to those that rule when comfort reigns. It was perhaps a far hark, from headquarters in the beautiful Hotel Astor to the excellent assembly room in the complete building of the United Engineering Societies, yet when President A. C. Humphreys convened the first session, at 10 A.M. of Wednesday last, it was quite discernible, from the number present, that the length of the route between hotel and headquarters was not to figure so largely in affecting the attendance as some surmised. In any event, when the gavel sounded the opening of the business period it is quite within bounds to say that seldom has the seating capacity of the beautiful auditorium in New York's temple of science been more taxed. The delegates truthfully represented all that is best in and of the ranks of those whose work lies in the furtherance of the aims of the gas industry; and it is only a fair tribute to them to declare that it is little wonder the industry thrives under the dominating of such appearing men. President Humphreys, as he stood before his fellow-workers, almost ready to sound the call, certainly presented a striking picture. How time does work its way. Not that he is not straight and lithe and sinewy and quick of resource as of old, but as the years go on it is undeniable that the manner of the student and the scholar prevail with him more and more. There was little time wasted in dallying. The programme called for a lengthy listing of work to do, and the order was started smoothly—and right here good credit should go out to Mr. R. S. Luqueer, Assistant to the President, whose Secretarial work was absolutely flawless. A surprisingly large addition having been made to the roll call by the admission of scores of new members, the annual report of the Board of Directors was considered. The document had to do with routine matters largely, although its recommendations contained some changes in the working rules of the Institute, one of which at least might lead to quite a difference in procedure. However, as all were eventually affirmatively sanctioned, even to the point of there not having been a single dissent, it would seem that the rule framing had been most acceptably adjusted. Then the convention settled down to listen closely to the Presidential message. Of course, it was scholarly. How, though, could it well be otherwise? Prepared by a man who is the responsible head of a lusty seat of learning that has well fitted out many a youngster for entering into the artificial lighting field as his life's work, and the progress of which under Dr. Humphrey's earnest, thoughtful direction has caused the world of teaching to watch it with fast increasing admiration, the address was that of a scholar, well tempered by the thought which wells from one possessed of a complete knowledge of his subject. The message had much to do with the omissions and commissions likely to arise from the close overseeing of the lighting industry by specially appointed State bodies. The message concerned other matters, too, an important one of these being the pointed references to the hard fact t[hat] if the full measure of success was to be gotten out of Institute w[ork], such work was to be shared in and performed by the greatest possible number of individuals. The address was followed by the report of the Nominating Committee, and these gentlemen had done their work so acceptably that all the choices were forthwith ratified without dissent. The result of the report was the election to office of the following:

President—C. F. Prichard, Lynn, Mass.
First Vice-President—W. H. Gartley, Philadelphia, Pa.
Second Vice-President—Donald McDonald, Louisville, Ky.
Secretary and Treasurer—A. B. Beadle, Philadelphia, Pa.

Some comment was made within our hearing as to the generally unexpected promotion of the gentleman from Kentucky; but elections often disclose apparently irreconcilable results. The speech of acknowledgment by Mr. Prichard was in that gentleman's best vein; which is surely good vein enough to convince one of his earnestness. Mr. Beadle's selection for the dual position of Secretary-Treasurer was well received, for there can be no doubt of his capacity to successfully handle the duties of this office, even though they are certain to grow to greater burden with each successive year. The Report of the Trustees of the Educational Fund, as submitted by Secretary Forstall, was then disposed of by routine. The statements in it showed fully that not only did the good work accomplished through its agency in the past continue, but that it fairly went ahead by leaps. That all the gas world is near akin was then beautifully proven by a resolution, framed and presented by Mr. A. G. Glasgow, mournfully acknowledging the death of the World's Dean of the gas industry, Sir George Livesey, whose memory will live while [illegible] exists. Here came a just recognition of service re[illegible] the ac-

LIBRARY OF CONGRESS. OCT 26 1908 SMITHSONIAN DEPOSIT.

ceptance of the report, by the Committee to Award the Beal Medal, who passed that honor to Mr. H. L. Rice, for his 1907 paper on "High Pressure Gas Distribution." Then followed in quick succession the reports from the following committees: "Public Relations"—this, which was presented by Mr. E. G. Cowdery, was merely a premise that the Committee had not forgotten the subject; "Technical," by Mr. W. H. Gartley; "Uniform System of Accounting"—in the absence of Mr. Carter, the findings were read by Mr. Prichard; and "Progress on Dipping Meters," by Mr. W. A. Castor. The latter led to a good discussion that was of real value. It was evident that this Committee had been keeping well up to its former records for diligent and painstaking work. Another Committee which had been up-and-doing was that concerned with the "Proceedings of International Committee for Standardization of Threads for Gas Appliances." It was presented by Mr. A. G. Glasgow, and it is a pleasure to here remark that this clever gentleman's Southern intonation has not been a bit spoiled by his long residence abroad. At this point the morning session was brought to a close by some pertinent announcements from the Chair; a notable one being the hope that all who possibly could would visit the excellent display of photometrical apparatus, which had largely been made by the united efforts of the N. Y. Edison Company, the Testing Laboratories Corporation and Mr. Preston S. Millar. The latter gentleman also offered a succinct explanation of the nature and type of the apparatus shown.

The afternoon session was convened promptly, and the first number considered was the excellent paper on "High Pressure Gas Distribution," by Mr. Jacob D. von Maur, of St. Louis. The discussion on this paper was spirited and interesting. One fact in connection with high pressure distribution that came out is the knowledge that much advance over the idea is going on in England, where the important firm of Bryan Donkin & Co. has arranged to take it up largely, and it is further worthy of note in such connection that the Donkin people seem inclined to favor for their part the fittings manufactured in America by the Reynolds firm at Anderson, Ia. The appointment of some standing committees was followed by the "Wrinkles" Budget prepared by the Editor, Mr. R. Bump, who is to be congratulated over the outcome of his year's excellent and painstaking work. The next order was a well put together paper by Mr. E. H. Earnshaw, on the theory of "Benzol Enrichment," who most interestingly detailed the law governing the absorption of these vapors. In the discussion Mr. F. B. Wheeler called attention to the effects of compression on the carrying capacity of gas for benzol vapors and cited some thought-compelling figures respecting actual experiences in the enrichment of low candle power gases. Mr. Prichard also gave figures showing large savings in cost through enriching by this process in mixed gases and coal gas. Further discussion by Messrs. Shattuck, Forstall, Coffin and Taussig showed that this subject is being given serious thought. Mr. F. N. Speller here read his paper on "Modern Wrought Gas Pipe." This also brought out a brisk discussion, the trend of which decidedly went to show that wrought iron pipes decidedly had the call over steel ones, so-called. The convention next listened to a report, handed in by Mr. A. G. Glasgow, concerning the proceedings of the "International Committee for Standardization of Threads for Gas Appliances." The debate thereon was closed by a resolution submitted by Mr. Glasgow that the conclusion of the Committee be indorsed. The Committee on President's Address, rather oddly too, having agreed to take up the duties implied by accepting the Committee position, came in with a "report" that, as the proceeding was a formality that might easily and with good reason be dispensed with, no report would be handed in. The "report" went, too. Mr. A. S. Miller, from the Committee on Pipe Standards asked for "more time" for consideration, etc. This also carried, for the Committee was ordered continued. The Committee on "Electrolysis" again asked for a continuance, that was granted, in the understanding that the finals on the subject would be presented next year. The Institute voted to meet next year in Detroit, and an adjournment for the day was ordered. The Reception Committee and its allies are working hard and successfully, and it may be satisfactorily added that the ladies, who are here in large number, are being attended to according to programme, with precision and deftness: but who could expect less from a band of hosts led by that *beau cavalier*, Mr. C. H. Dickey. The central figure of the hour, it is fair to say, is Chief W. H. Bradley, although not a few assert that Uncle Jerry Howard presses near to him.

The second day's sessions were begun before an attendance that was not altogether up to the standard of the opening day. However, reason suggests that the morning was such a glorious one that many preferred to walk from their hotels rather than seek the aid of trams or 'buses. The auditorium rapidly filled when the pedestrians came trooping in, and when the reading of the Report of the Committee on Calorimetry, which was the first topic considered, was well underway, the attendance was of rousing nature. This report was profusely illustrated with many excellently well-handled lantern slides, and Mr. Klumpp's explanations concerning these were terse and plain. The discussion on this subject was interesting all through, even if somewhat prolonged, and a notable contribution to it was the speech made by Prof. Burgess, whose close identification with the State Commission of Wisconsin looks a good thing, whether viewed from either the consumers' or the lighting industries' standpoint. The excellence of the report fully merited the unqualified approval vouchsafed it by President Humphreys. The findings of the Committee on defining the unit respecting the heating value of gas (presented by Mr. Walton Clark) having been indorsed, Mr. H. L. Rice here submitted a partial report in the instance of the proposed joint exhibition of appliances and apparatus by the Institute and the National Commercial Gas Association in Chicago next December. The partial progress report betokens that everything in this connection was moving harmoniously toward complete success. Mr. C. O. Bond next read "Some Further Remarks on the Photometry of Gas." Very sensibly the Chair decided that, as two other contributions to the technical list (the Report of the Committee on Unit of Light, by Mr. W. H. Gartley, and "Better Gas Illumination," by Mr. Thos. J. Litle, respectively) were kindred of the Bond presentation, these should be read and the trio discussed conjointly. The debate that ensued was a noteworthy one, as it should have been, considering alone the matter for creating such in the fruitful sentences put forth by Mr. W. H. Gartley, whose ranking as a practical applier of ways to the benefits springing from research goes consistently higher. The Litle paper was set forth with lantern views, prominent in which were the faces of Prof. Bunsen, Dr. Auer von Welsbach and Dr. Shapleigh. Editor Elliott, of *The Illuminating Engineer* was invited by request to share in the discussion, and his part therein was an eminently practical one. Quite some diversity of opinion was expressed over the relative merits of tungsten and mantle gas lighting illuminating yields, but in this duel the Searle-Gartley combination seemed to have much the better of the argument, which means that gas lost nothing in the light of the relative facts brought out. A smart feature of this exchange of opinion was a clever and clear speech from Dr. Hyde, of the United States Bureau of Standards, whose efforts on behalf of the standard unit will long be remembered by the gas men who were thus so happily brought in close relations with him. The discussion was not concluded until well after the hour set for adjourning, which meant the putting of 3 regular numbers over until to-morrow. The entertainment of the good halves of the visitors has been maintained without flourish or fuss, but with a cordial heartiness that cannot fail to result in enjoyment to the participants and in satisfaction to the Committeemen. The Consolidated Gas Company, headed by its chief executive, Mr. Walter R. Addicks, and by its chief engineer, that finest of veterans, Mr. Wm. H. Bradley, aided by Lieutenants Woods, Morris, Simpson and Carter, and subalterns Postley, Fogg, *et al.*, are to be congratulated over the nicety of their plannings and the excellence of their ways-and-means of carrying out such plannings for the entertainment of the great numwho this year availed themselves of the Institute's invitation to be with it and of it.

The banquet was as a forecast of it promised. Perhaps 500 shared its pleasures, material and mental. The man who manœuvered its ways was none other than Captain McKay, whose sallies were as irresistible as his wit was enjoyable, for even out of his castigations no mutiny arose. In harbor safe and snug the good ship fraternality was moored, and her swayings were caused solely by the tides of sturdy friendship, which surely this night were at their highest. The set entertainment for the ladies was a visit to the Hippodrome to take safe part in the "Battle in the Skies."

The banquet seemed to have exerted some effect on the attendance the morning of the third day, for the attendance (by comparison with that of the prior two days) was not quite up to standard. However, it was sufficient to show that the meeting was still a potent magnet. The opening number was the Bureau of Information budget handed in by Chairman Baehr. Your readers need not be told of the great, good work done by the Bureau this year, for they have had it all in the JOURNAL, and it goes without the narrating that it has been of positive use to many a member and to non-members as well. However, remembering that Friday is your "press day," I will just give the heads in order of the business transacted my only comment being that the technical work in hand this morning, between the hours of 10 and 12:30, would really afford pabulum for a full day's session. The second topic was the report of the Board of Revision in respect of the Question Box, narrated by Mr. J. D. Shattuck. Then followed these two papers which, being upon mainly kindred subjects, were read in order and then discussed in union: "Vertical Retorts," by Mr. J. H. Taussig, and "The Physical Theory of Coal Carbonization," by Mr. W. H. Fulweiler - the last one was a gem. The discussion on these papers—the first was most intelligently illuminated by a series of slide pictures—was naturally brisk, interesting and prolonged. Owing to the absence of the author (Mr. C. J. Ramsburg) his paper on "Holder Cups and Tank Heating," was ordered taken as read, and the technical part of the sessions was closed by a "Chapter of Accidents" that happened in the ordinary course of working. The untoward troubles were respectively and interestingly narrated by Mr. D. F. Burritt, Mr. W. H. Gartley and Captain W. E. McKay. These more than ordinarily interesting recitals marked the termination of the technical business of the convention, which was also marked by a graceful, forceful speech of thanks by President Humphreys to those who had so ably assisted him in the arduos tasks of preparing the routine which so greatly facilitated the carrying on of the meeting. Sturdy words of acknowledgment to President Humphreys and his aides for their persistently harmonious work, uttered as a finality by Mr. Walter R. Addicks, had this for a strident close: "I regret the Constitution and other laws of the Institute forbid us from re-electing our retiring President for another term."

Now all is in readiness for the trip to the Astoria plant, at Casino Beach, of the Consolidated Gas Company, and the automobile trip around the city which will be taken by the ladies during the men's voyaging to Long Island. Regretfully is it written that rain into the day is now falling, and the ardor of the voyagers may be somewhat damper than was expected. Nevertheless, rain or no rain, the trips will be made. As to the doings of to-night and to-morrow, the retailing thereof must go over to another day.—C.

Holder Cups and Tank Heating.

[A paper written for the Third Annual Meeting of the American Gas Institute, by MR. C. J. RAMSBURG, Philadelphia, Pa.]

Question No. 17 to the Bureau of Information was as follows:

"What is the plan of piping to use to keep the water in the tank and cups of a 400,000 cubic foot gasholder from freezing, in a locality where the mercury drops to 30° below zero?"

There were three replies to this question, each containing valuable information, two of which were the result of practical work in districts where such weather was experienced. It has occurred to me that the subject was worth a somewhat closer study, and, at the request of the Technical Committee, I have prepared the following notes.

Undoubtedly the problem of preventing the formation of ice in the steel tank and cups of a holder that is in an exposed position, and subjected to an occasional temperature of 30° below zero, is as difficult a one as we have to encounter, for it appears in such cases that complications arise that are unknown in the operation of the average holder in this country. The difficulty is possibly due to the fact that where the water is in a quiescent state, as in a holder tank, it is possible, and frequently happens, that it falls several degrees below freezing, in which condition a slight motion will suddenly convert it into anchor ice which will adhere to the sides of the tank. This is an exemplification of well known phenomena. Cases have been known where a very considerable quantity of ice was found present at a point at which tests shortly before showed the presence of no ice. In such a case it is necessary to take the precaution of seeing that the water at suspected points does not fall below such a temperature as will leave a margin, sufficiently large in the judgment of the superintendent, to provide against usual climatic conditions and sudden abnormal changes in temperature.

Experience has further shown that, when the lower lift of the holder is landed, there is a tendency toward the formation of ice along the sides of the tank, on the weather side more rapidly than where a freer circulation can be obtained, and under the condition where the cold side is in direct communication with the warmer, central portion of the holder. There are cases also in which the presence of considerable quantities of tar in a holder tends to make trouble through thickening and through stratification, preventing the circulation during cold weather. The presence of ice in a tank may not only cause serious bending or wrinkling of the holder sheets and grips, but it may cause the cups to leak by settling on the ice. There have been instances where so much ice was found in a holder tank as to lift the framing for the crown support, which, of course, is a very serious matter.

Having fixed upon a temperature for the water in the holder tank, it should never be necessary to admit steam unless the temperature falls below a standard, which say is 40°, at which are believed to be the coldest points in the tank. It would seem judicious to decide to always admit steam to these points as soon as the temperature falls below this. The basis for economy will consist of frequent observations of temperature, turning off the steam when it is not needed and turning it on again when it is shown to be needed. This appears like unnecessary advice, but it is by no means unusual to find that the turning on of the steam has been postponed too long, or neglected, and in other cases it has been turned on in November and left on until March, under which conditions the temperature in the tank may be as high as 90°, or, upon the event of a particularly cold spell, this constant amount of steam may prove insufficient to meet the abnormal conditions, and ice results.

Methods for Steam Admission.—In effecting the ice prevention three methods appear to be in use for the admission of the steam. One is simply to introduce a line of piping, ½ inch or ¾ inch, with or without an elbow, to give a current around the tank and blow live steam right into the point or points desired. Another method is to take the water, by means of an ejector, from the top of the tank and introduce it half-way down and at the bottom. The argument offered for this method is that the surface of the tank water, between the sides of tank and holder, being necessarily warmed by other jets, will thus introduce the warmest water obtainable, further heated by the ejecting steam, to the coldest locality, or to the bottom, from which it rises and insures circulation at the cold points. The third method is to pick the cold water up by an ejector from the coldest points and depend upon the replacement by the somewhat warmer water adjacent thereto, and the rapid motion of the water itself, to prevent the formation of ice. I am unable to say whether the second or third method is the best, but I believe that either is better than the first method, and will say that we have had success by using the third.

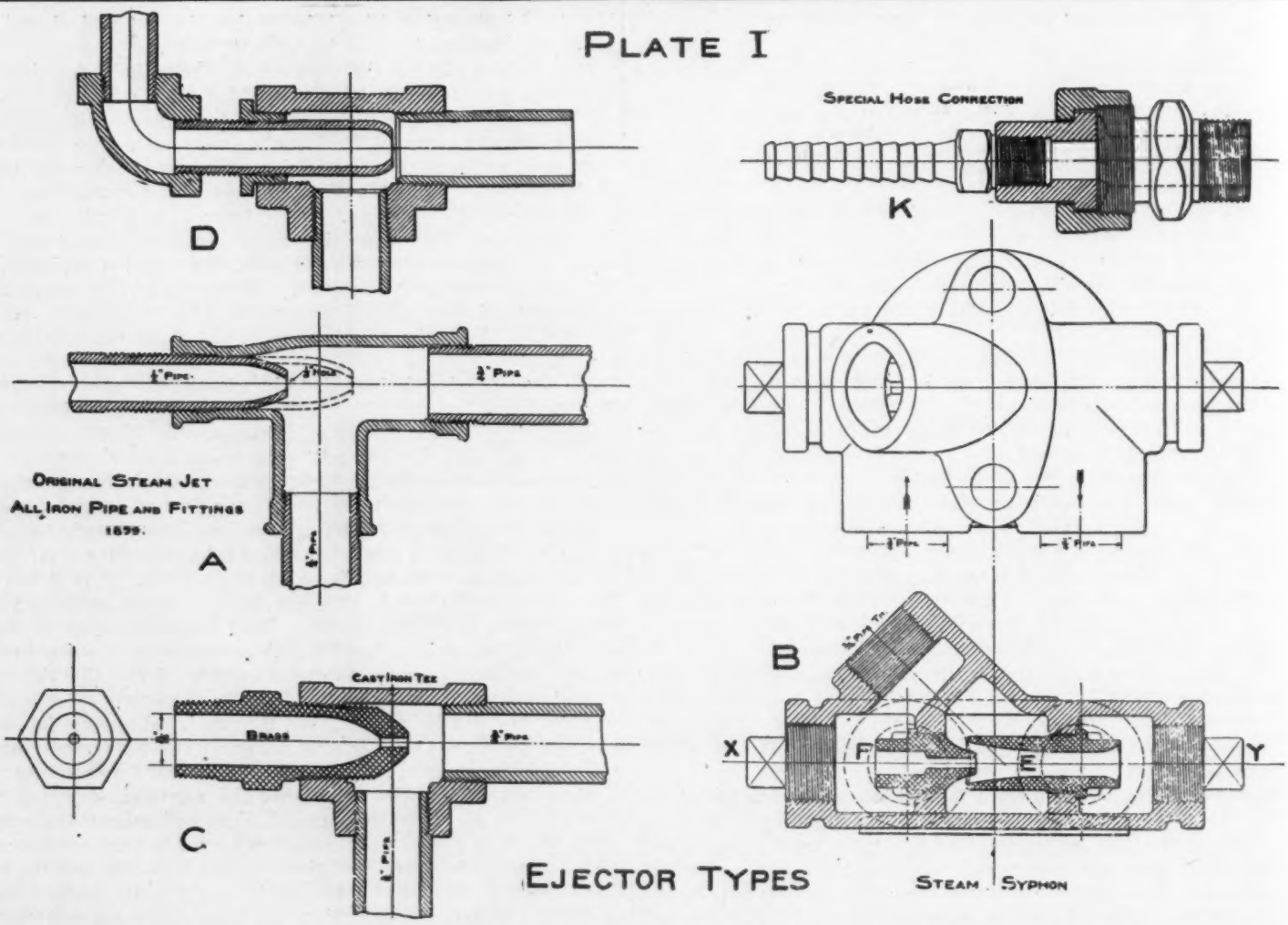
There is no doubt that the superintendent must judge for himself at how many points it will be necessary for the ejectors to be put to work. Local conditions in addition to the ordinary climate will be factors that will control. The introduction of steam along the surface of the tank and in the cups we recommend should be done by the use of ejectors which pull the water from the bottom and send it along in a current around the surface. While there is no novelty in this at the present time, I am aware that it is not universally used and that many superintendents still use the inserted open end of a pipe. I believe this is wasteful of steam, for, using an ejector, the temperature can be maintained at a lower temperature without danger of freezing by reason of the motion that is given to the water through the cups and tank.

Ejectors.—Having decided that the ejectors are more economical than the use of live steam blown directly into the water, it is pertinent to discuss the different designs of this apparatus. What we wish to obtain is an ejector which will give the most circulation with the smallest amount of steam, and will operate at the lowest steam pressure. We have examined into quite a number of designs, have experimented with quite a few types, and have in this study found an ejector which we think covers the object to be attained successfully.

On Plate 1 are shown four types, *A*, *B*, *C* and *D*. Type *A* was put in service in our plant in 1899, and we were much gratified to get what we thought excellent results. They had been in service but a short time when we discovered that the consumption of steam had increased enormously, and upon examination we found that the steam orifice had eaten away so that the diameter was nearly twice as great as when first put in service. We then designed another jet which possessed the advantage of having an easily removable and cheaply replaceable steam orifice. This design was sent to a well-known firm of steam specialists, who re-designed the apparatus, evolving that shown in type *B*. This they patented. You will notice that the steam orifice shown at *F* has the advantage of having a long opening; another advantage in the finished ejector is that both this and the cup-shaped piece *E*, into which the steam is delivered, are made of hardened brass. The size of this orifice is ½ inch. From its construction and from the material of which it is made it disintegrates very slowly, and consequently delivers a constant supply of steam at a steady velocity for a long period. Should these need to be replaced it is easily done by removing the plugs *X* and *Y* and placing new parts in position. We have had these ejectors in service for between 6 and 7 years. Our experience has shown that, where the steam supply carries quantities of entrained water, it is necessary to replace the orifice each year, while with drier steam we have had them in service for 5 years without replacement. The cost of this ejector complete is $4.25, and removable steam nipple about 30 cents. Type *C* we designed as a cheaper article than *B*. This proved superior to *A*, inasmuch as it had a longer orifice in the nipple, which was made of brass instead of iron. This did not suffer greatly from deterioration, but we found further that *C* did not possess the efficiency as an ejector that *B* did. *B* would take up the water and discharge it at a rapid rate with but 5 pounds steam pressure and continue to operate until the pressure was almost cut off. Type *C*, on the contrary, would splutter at 18 pounds and pick up only when 22 pounds was reached. It ceased to operate at low pressures. We have, therefore, adopted type *B* as our standard ejector, inasmuch as it fills efficiently all the conditions that we originally asked in an ejector.

I will call your attention also to type *D*. This shows an ejector made of wrought iron pipe, and was sent in with one of the replies to Question No. 17. This costs perhaps only one-third as much as type *B*, with the time taken to make it, but our experience has shown that it uses the steam much less efficiently—that the orifice wears away rapidly, increasing the amount of steam in proportion to the circulation, is more difficult to take apart, requires a higher steam pressure, and, in general, is a home-made device that should be replaced with a first-class mechanical one, such as shown in this ejector.

Number and Position of Ejectors.—The number of ejectors necessary on a holder, and their position, are of course, as I have said, matters which the superintendents must decide for themselves, in accordance with local conditions. In holders between one and three million feet capacity we have found that there should be eight ejectors in the tank. That is, this number provides a sufficient factor of safety, so we are sure that in zero weather they will prove sufficient. Of these eight, four draw from the bottom and discharge half-way up, and four draw half-way up and discharge just below the surface.



These alternate around the tanks, the majority of them, however, being placed on the weather side. In the same manner we find that four ejectors for each cup are sufficient. The majority of these are also placed on the weather side.

In passing I may mention that where the holder is provided with outside stiffening legs, which practically cut off communication between the bays, that an ejector should be provided for each bay.

Steam Hose.—The selection of the quality and kind of steam hose depends in a large measure on how it is proposed to put the steam in the cups and tanks. If the steam is to be simply blown in, without an ejector, long years of use give an undeniable standing to rubber hose; but if ejectors are to be used, rubber hose gives more trouble, on the whole, and is less satisfactory than metallic hose. It would not be proper to entirely condemn the use of rubber hose, even with the ejectors, since our experience has shown this variety to have been in use several years without trouble. On the whole, we find the metallic hose proves less troublesome than rubber. The principal difficulty with the use of rubber hose when using ejectors is that the inside disintegrates, causing small particles of rubber and canvas to clog up the steam orifice. It also suffers from outside deterioration, either by weathering or from coming in contact from time to time with holder oil. It stiffens and hardens during the summer months when in disuse, and must be frequently replaced.

The alternative is to use metallic hose. This, I think, will give general satisfaction, though it also has certain drawbacks, chief among which is the difficulty experienced in keeping it properly lagged. The manufacturers of this article have for years tried to find a covering which, while sufficiently flexible, would not char from the inside and would stand weathering. A covering that is a combination of rubber and canvas rapidly deteriorates; wool-felt and silk-felt both burn out in a short time. The most satisfactory covering which has been proposed up to the present time is made up of asbestos wick, wound closely and fastened securely with fine copper wire around the hose. While this is in the process of being tried out, as it were, it seems to show improvement over the other varieties experimented upon. One other point in regard to metallic hose must be closely followed. It is necessary to use much greater precaution to prevent the hose from freezing up than with rubber, inasmuch as it is almost impossible to lower the metallic hose from the holder and thaw it out successfully without seriously injuring it. On the contrary the rubber hose does not require such care, though of course that which the metallic hose requires is only what any good routine would demand. After all is said, the metallic hose has proved that it is superior to rubber hose. I know of metallic hose which is in first-class condition after 8 years' continuous winter service—while the best record for rubber hose with which I am acquainted is 5 years, and this is exceptional.

A point which might be mentioned in connection with metallic hose is the advantage shown by the use of ½ inch over ¾ inch. This smaller size supplies ample steam for a single jet, yet does not subject the connections to as great a strain on account of its smaller weight. It does not leak or require as much repairing, and its original cost is less. With the use of ½-inch hose, and with the improvements made in the couplings, the objection to metallic hose[1] on account of leaky couplings is practically eliminated. The approximate prices are as follows:

¾-inch 5-ply rubber steam hose	41½ cents a foot.
¾-inch 4-ply rubber steam hose	31½ cents a foot.
½-inch 5-ply rubber steam hose	33½ cents a foot.
½-inch 4-ply rubber steam hose	25 cents a foot.
¾-inch metallic tubing with asbestos covering	$1.27 a foot.
½-inch metallic tubing with asbestos covering	.95 a foot.
¾-inch metallic tubing without covering	1.20 a foot.
½-inch metallic tubing without covering	.90 a foot.

There is also a metallic hose, made in Germany, sold in this country at a lower price. I am not prepared to discuss in a paper of this character the relative merits ot each.

From this it will be seen that the metallic hose costs about 2½ times as much as the best grade of rubber hose, that it can be counted on to last three times as long, while giving during the whole period more satisfactory service, makes it a profitable investment.

Steam Supply to the Holder.—Trunk Main.—In the main steam supply to the holder two methods prevail. One is shown in the drawing accompanying the answer to the question. This shows a circular pipe hung from the tank gallery. In such an arrangement the method usually employed is to run the pipe from the boiler above ground to

1. Imported from England.

this circular ring and allow the condensation to drain back towards the boiler.

After a considerable experience with this method I am led to believe that it can be improved upon. In addition to being subject to freezing, the fact that the lagging must be subject to weathering winter and summer is undesirable and makes it difficult and expensive to keep it in proper condition.

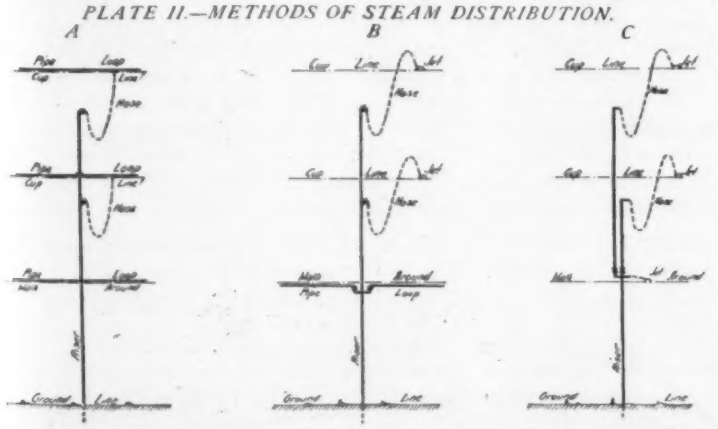
There appears to be no pipe covering that will stand the heat of 50 pounds steam pressure that will not be entirely ruined in a short time if it lays in water or is exposed to heavy rains. In order to prevent the moisture from entering the covering and in the lagging, it is necessary to cover the outside with canvas which, in turn, must be painted from time-to-time. The painting itself deteriorates the lagging, inasmuch as the oil from the paint cakes it. The inaccessibility of this pipe for repairs and said painting is easily realized. Instead of this arrangement I suggest a thoroughly good job of underground steam piping. This means a line of steam piping encircling the holder underground so arranged that it will not have to lay in water from melting snow or heavy rains, and one that will be able to resist a fair amount of moisture without impairing its value. It also should be laid below the frost line.

We have experimented with various methods of laying this pipe, including "Wyckoff Coverings," Nos. 1 and 2 grade, placing the main inside of terra cotta, depending on dead air space lagging, inside of wooden boxes lagged with a mixture of coke breeze and pitch and with asphalt, none of which have given us entire satisfaction. We have recently come across a method which is worth considering. This system is exploited by the H. W. Johns-Manville Company, and is as follows:

Stoneware pipe sections are delivered, so scored that a gentle tap is sufficient to break them in two. Longitudinally the bottom half of this is laid, and at intervals Tees are placed looking down and firmly embedded in concrete. In these Tees are placed iron supports for rollers which hold the steam pipe to be run from the bottom of the stoneware section. After the bottom sections are laid, the steam pipe is run, resting on the rollers. The whole line of pipe can then be tested. This being done, the space below and above the pipe is packed with asbestos sponge and the upper pipe sections put on. This scheme also embraces an underdrain of loosely laid terra cotta pipe. A steam main laid in this manner they claim to be well lagged and insured against moisture and ground water. Another suggestion is to lay the main in vitrified terra cotta pipe, testing each length of steam pipe before stringing the terra cotta pipe on it, and filling each length with lagging material, when in place; the main to be made concentric with the terra cotta pipe by means of supporting blocks. The whole is to be put in concrete. I should be very glad to hear any criticisms on this. As I have said before, I believe the underground steam pipe to be better than the overhead pipe running around the tank gallery, from the standpoint of economy, safety and convenience, though, of course, the initial cost is much greater.

Steam Distribution on the Holder.—There are several methods of distributing the steam to the jets. These are shown on Plate 2. First:

PLATE II.—METHODS OF STEAM DISTRIBUTION.



To run one or more main risers and connect them to encircling pipes hung on each cup gallery, from which short connections are made to the various jets in the cup. Second: To run single risers at intervals around the holder, from which connections are made to jets placed above one another on the various cups. Third: To run a single riser from an underground main to a point just above the tank gallery to a manifold, from which point individual risers are run, each to a single jet, all of which are controlled from the manifold. The first and second methods I do not think recommend themselves, because they are subject to freezing; the lagging becomes ineffective and rapidly deteriorates; the control of the steam of each jet requires climbing on the part of the holder man to that point. The chief objection to these methods, however, is that they do not insure the delivery of steam to each jet in the quantity needed. With the second method it is also additionally likely that there may be a leak in the steam valve controlling supply to jet through a hose, and the hose be frozen where the water in one cup requires heating, while another does not.

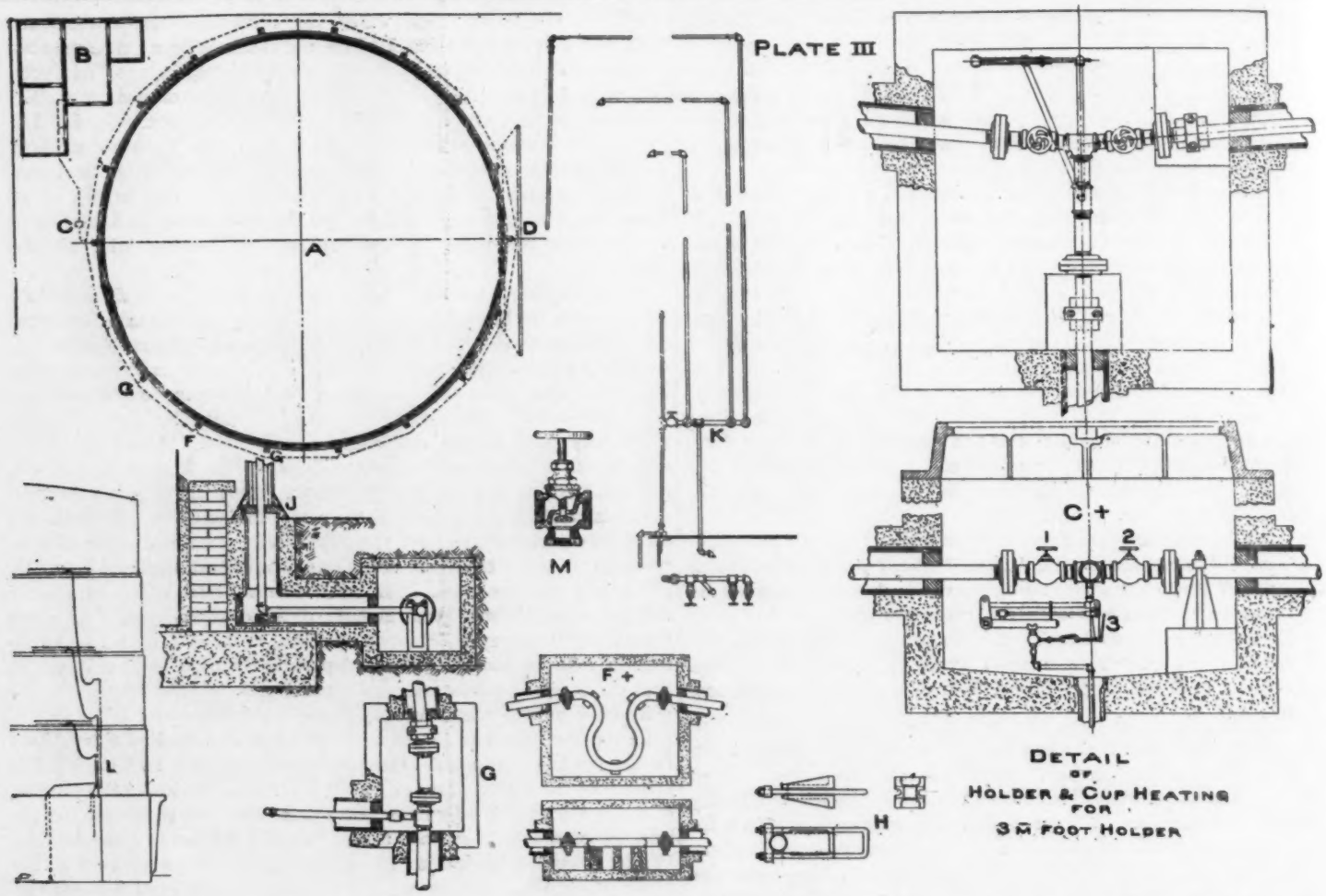
With running the single riser to each jet from the main manifold, it is possible for the holder man to control the steam to each and every jet on that portion of the holder from one point. It also enables him to drain each riser separately by the use of a 3-way valve, and makes it positive that, when the steam is shut off, there is no accumulation of condensation in the riser to freeze and give trouble. I will describe this 3-way valve and its application a little later. These single risers are run to a point about midway between the highest and lowest position that the cup can possibly reach. At each point they are run over horizontally for a short distance and turned down. To these are attached one end of the hose, the other being attached to the jets on the cups. On the handrail, and firmly bolted to it, is placed a saddle, into which the hose rests. This will be shown later. The purpose of this is to take the weight of the hose off the connections and to allow a very free movement, either up or down, without kinking or twisting. It also has the purpose of supporting the hose so that it can be kept outside the rail on one side and inside on the other. On the whole this method seems to be superior to the other two.

I have now discussed, in as much detail as our limited time allows us, the various methods for accomplishing the safe and economical heating of the cups and tanks of a holder. For the sake of discussion of the subject I will now show some details of the plan used for the heating of a 3-million foot holder recently erected in Philadelphia. While, of course, such a holder will never experience a temperature of 30° below zero, or probably a temperature below even zero, nevertheless I cannot see why the same principles cannot be applied on the holder that is mentioned in Question No. 17.

Plate No. 3 shows at *A* a cross-section of the holder, which is 180 feet in diameter. The boilers, two in number, equipped with forced-draft to maintain a constant steam pressure, are located at *B*. The main steam line is run to point *C*, at which it branches and encircles the holder. This encircling steam pipe and the steam pipe from the boiler are laid so that the point *C* is the lowest point in the entire main; point *D* on the opposite side is the highest point. At the lowest point, namely *C*, the three mains are brought together and connected by means of flanges. A detail of this is shown at *C+*, which is a concrete manhole. The purpose of these flanges is to allow repairs to be made readily. The steam valves at 1 and 2 are shown controlling the passage of steam each way on the encircling pipe. The chief feature of this manhole, however, is the steam trap 3, which is an expansion trap, by which condensation in the entire steam system is removed.

Returning now to the plan of the holder *A*, it is necessary, for the sake of economy and to take up expansion, to lay this pipe in straight runs. In this instance the length of each run is about 32 feet. In a pipe of this character, of course, it is necessary to supply expansion curves, and, therefore, necessary to also anchor the pipe at other points. *F* and *G* are alternately expansion curves and anchor points. A detail of the expansion curve is shown at *F*, which you will see consists simply of a U-shaped pipe bend. *G* shows a method used for anchoring, which consists of burying a wrought iron U-shaped bar of iron in concrete, on which are slipped the castings to clamp the pipe in position. A detail of this is shown at *H*. This entire steam main is to be laid, according to the plan of which I have spoken, in concrete covered, terra cotta pipe. From this main steam line 4 main risers are taken. The method of running this pipe from the ground main is shown at *J*. One feature of this is that the covering pipe, which projects from the ground, is cast iron instead of terra cotta. This is to prevent deterioration from frost which would ensue if the latter material were used.

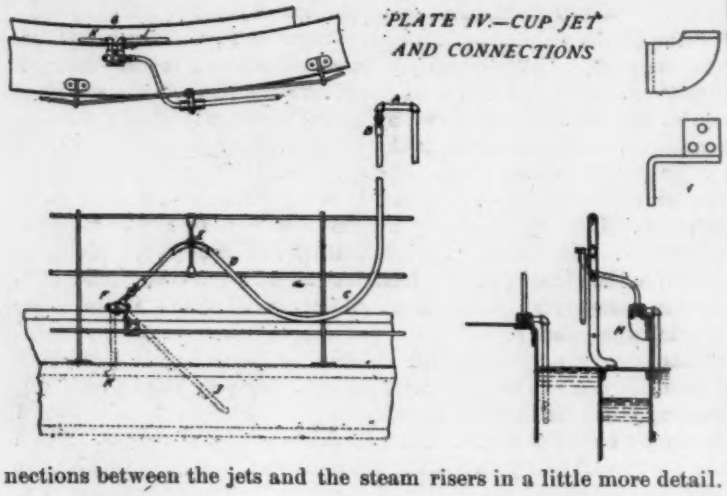
These risers are covered with material in three layers, consisting of moulded mineral wool in contact with the pipe, next ½ inch felt covering this, held in place by rawhide paper, outside of which is run a surface retainer of rubber-treated canvas, or No. 27 copper. These rises are carried to a point on the holder shown at *K*, from which the individual risers and the supply of steam to the cup siphons are run,



a detail of this is shown at *K* +. In this you will notice the principal riser supplying the manifold, the secondary risers and the connections for the tank heating. The tank heating is accomplished as shown at *L*, where one siphon is shown operating drawing the water from the bottom of the tank and discharging it in the center; the other, drawing from the center and discharging at the top. These two are placed a short distance apart, the one furthest from the manifold being carried on the cross-girder and dropped down the next diagonal support.

The valves on this manifold are 3-way valves. These provide a safe and effective means of draining the risers, inasmuch as, by closing the valve, a discharge is provided for the condensation which is positive. A detail of this valve is shown at *M*. One feature of this valve is worthy of comment – steam on the riser must either be on or off; there is no in-between. This enforces the holder man to cut down the number of jets, rather than the steam to each one, so that a jet cannot be supplied with an inadequate amount of steam to prevent freezing of the hose. There is also better circulation of the water in the cup if the same amount of steam is applied to few siphons rather than to many.

Plate 4 shows the installation of the jets on the cups and the connections between the jets and the steam risers in a little more detail.



At *A* you will notice the riser turned down, upon which is connected a union, *B*. The hose *C*, which is ¼ inch metallic hose insulated with asbestos wick covering, runs outside the rail at *D*, over the saddles *E*, and connects to the jet *F*. *G* shows the method of placing the jet on the cup. This is placed and held in position firmly by a jet support, shown in detail at *H*, firmly fastened to the dam. *J* and *K* show, respectively, the inlet and outlet connections, which are run into the side of the jet on an elbow allowing either or both to be pulled out of the cup water.

In this connection I might mention that the discharge on the jet *K*, is run but a short distance below the surface. In addition to this providing excellent circulation around the top water in the cups, it insures to some extent the cup from siphoning back through the hose in the event of any accident, inasmuch as the pipe would soon unseal itself. This is hardly true when the top cup is in its highest position, inasmuch as the constantly increasing pressure raises the water in the cup thus increasing the seal.

It may prove of interest in connection with this description to show a copy of the form used by the holder men to insure the maintenance of proper temperatures. This is shown in Plate 5. This data is taken and recorded under instructions as issued from time to time by the Superintendent of Holder Stations. The chart speaks for itself.

Plate 6 shows the amount of coal used in heating tanks and cups of two holders at the Germantown holder station of the Philadelphia works during the winter, 1907–1908, operating under such a system.

PLATE VI.—Holder Station Boiler Fuel.—Germantown Station, Phila. Works.—The United Gas Improvement Co.

2 Holders—Capacity { No. 1—535 M. / No. 2—795 " } Total 1330 M.

Boilers 2 Horizontal Tubular 45 H.P. Each.

Month.	Coal burned per Day.	Total per Month.	Kind.	Av. Temp. per Month.	Coldest Day Av. Temp.	Minimum Temp.
Dec. 1907	361 lbs.	5 tons	Buckwheat	39°	26°	21°
Jan. 1908	2457 "	34 "	"	35°	15°	9°
Feb. "	3940 "	51 "	"	31°	17°	5°
Mar. "	717 "	10 "	"	45°	29°	24°
Ave ...	1836 "	.....	.....	37.5°	.....	.....

PLATE V.—THE UNITED GAS IMPROVEMENT COMPANY.—PHILADA. GAS WORKS.
TEMPERATURE REPORT HOLDER No. 2. STATION, *Germantown Holder, Feb.*, 1908.

Date of Month.	Time Taken.	ATMOSPHERE. Kind of Weather.	Direction of Wind.	Velocity of Wind.	Temp. top Holder.	Temp. btm. Holder.	TANK TEMPERATURES. Surface of Tank.	3 ft. below Surface.	15 ft. below Surface.	25 ft. below Surface.	Lower Jets on	Surface Jets on.	CUP TEMPERATURES. Top Cup.	Jets on.	2nd Cup.	Jets on.	3rd Cup	Jets on.	4th Cup.	Jets on.	GAS TEMPERATURES. 1 ft. below Crown.	10 ft. below Crown.	50 ft. below Crown.	3 ft. above Water.	3 ft. above Inlet.	3 ft. above Outlet.	REMARKS.
1st	8 A.M.	Lt. Rain	S.E.	24	40	40	—	—	—	—	—	—	43	2	45	2	—	—	—	—	—	—	—	—	—	—	Steam off 10 : 30 A.M.
2nd	"				17	19	—	—	—	—	—	—	36	2	38	2	—	—	—	—	—	—	—	—	—	—	" on 11 : 00 P.M.
3rd	"				26	28	40	40	39	38	4	2	38	2	39	2	—	—	—	—	34	34	35	36	37	36	
4th	"	Pt. Cloudy	N.	10	15	17	—	—	—	—	—	—	39	2	39	2	—	—	—	—	—	—	—	—	—	—	
5th	"				21	22	42	42	40	40	3	2	39	2	39	2	—	—	—	—	36	36	38	38	39	39	Steam of 9 : 00 A.M.
6th	"	Clear	N.	10	40	40	—	—	—	—	—	—	42	2	44	2	—	—	—	—	—	—	—	—	—	—	" on 12 : 00 M.
7th	"	Cloudy	S.W.	15	25	27	38	38	37	37	4	4	36	2	38	2	—	—	—	—	34	34	36	36	37	36	
8th	"	Clear	N.W.	12	18	19	—	—	—	—	—	—	36	2	36	2	—	—	—	—	—	—	—	—	—	—	
9th	"	"	"	11	19	20	—	—	—	—	—	—	37	2	38	2	—	—	—	—	—	—	—	—	—	—	
10th	"	"	N.	2	30	30	40	40	39	39	4	4	38	2	38	2	—	—	—	—	36	36	37	37	38	38	Steam off 12 : 00 Noon.
11th	"	"	N.W.	7	42	42	—	—	—	—	—	—	40	0	39	0	—	—	—	—	—	—	—	—	—	—	
12th	"	Pt. Cloudy	N.E.	9	39	39	39	39	37	37	0	0	39	0	39	0	—	—	—	—	37	38	38	38	39	39	
13th	"	Lt. Rain	"	8	44	44	—	—	—	—	—	—	42	0	42	0	—	—	—	—	—	—	—	—	—	—	
14th	"	Cloudy	N.W.	5	48	48	43	39	39	39	0	0	41	0	44	0	—	—	—	—	68	68	68	66	66	66	
15th	"				52	52	—	—	—	—	—	—	50	0	50	0	—	—	—	—	—	—	—	—	—	—	
16th	"	Clear	W.	10	37	37	—	—	—	—	—	—	39	2	39	0	—	—	—	—	—	—	—	—	—	—	
17th	"	"	N.W.	"	30	31	34	34	33	33	4	4	34	2	34	2	—	—	—	—	35	38	40	40	40	40	Steam on 1 : 30 P.M.
18th	"	"	"	8	27	28	—	—	—	—	—	—	42	2	42	2	—	—	—	—	—	—	—	—	—	—	
19th	"	Snow Rain	N.E.	6	36	36	60	55	42	40	2	2	42	2	42	2	—	—	—	—	33	34	35	35	35	35	Steam off 12 : 00 M.
20th	"	Clear	N.W.	8	27	28	—	—	—	—	—	—	36	2	36	2	—	—	—	—	—	—	—	—	—	—	" on 2 : 30 P.M.
21st	"	Cloudy	S.W.	12	32	34	60	50	45	43	2	0	46	2	47	2	—	—	—	—	34	35	35	36	36	36	
22nd	"	Clear	N.W.	15	30	32	—	—	—	—	—	—	42	2	42	2	—	—	—	—	—	—	—	—	—	—	
23rd	"	Cloudy	S.E.	6	31	31	—	—	—	—	—	—	44	2	44	2	—	—	—	—	—	—	—	—	—	—	
24th	"	Clear	W.	6	26	26	55	50	42	40	3	0	42	2	42	2	—	—	—	—	38	39	39	39	39	39	
25th	"	"	S.W.	5	39	39	—	—	—	—	—	—	44	2	44	2	—	—	—	—	—	—	—	—	—	—	Steam off 1 : 00 P.M.
26th	"	Rain	E.	6	40	42	50	45	38	38	4	0	38	0	38	0	—	—	—	—	39	39	39	40	40	40	
27th	"	Clear	S.W.	10	38	40	—	—	—	—	—	—	40	0	40	0	—	—	—	—	—	—	—	—	—	—	" on 11 : 00 P.M.
28th	"	Cloudy	N.W.	15	21	22	50	42	42	40	4	2	34	2	34	2	—	—	—	—	34	34	33	33	33	33	
29th	"	Clear	"	5	22	24	—	—	—	—	—	—	38	2	38	2	—	—	—	—	—	—	—	—	—	—	

Both of these holders are tank holders with a total capacity of 1,330,000 cubic feet. You will note that the average amount of fuel per day amounted to 1,836 pounds, and the total amount of coal for the 4 months 100 tons, buckwheat grade. While this showing is not remarkable, I think you will agree that it denotes economical operation. In addition I may say that not once during the winter was there an indication of any ice formation. The coal used includes that for heating the valve and boiler house.

Some Further Remarks on the Photometry of Gas.

Written for the Third Annual Meeting of the American Gas Institute, by MR. CHARLES O. BOND, Philadelphia, Pa.

The Institute will appreciate the difficult task approached in endeavoring to comply with the request for "Further Remarks on the Photometry of Gas" when there is recalled to mind the full report of the Committee 1 year ago. Yet that report left a few questions open, and these are of such basic importance as should provoke general discussion at this meeting. This paper may be divided under five headings:

(1.) Suggestions for bettering conditions within the photometer room and for improving the accuracy of settings.

(2.) Sampling the gas to be tested.

(3.) The selection of suitable reference and working standards.

(4.) A discussion of what should constitute a test burner.

(5.) Speculative remarks as to the future of photometry in the gas industry, and of the relation which the American Gas Institute should bear to it.

(1.) *Suggestions for Bettering Conditions within the Photometer Room and for Improving the Accuracy of Settings.*—(a) In the scheme submitted by the Committee for securing adequate ventilation in the photometer room, it was shown that it would be necessary to move 36,900 cubic feet of fresh air through the room each hour in order that the CO_2 content (which served as a measure of the vitiation) should show no appreciable increase. In the case supposed there was one person, one pentane lamp and one gas flame, each discharging its products of combustion into the room, and these together comprised the sources of vitiation.

This seems a large volume of air to move, and raises the question whether, in very cold weather, it would be feasible to properly heat it before its admission to the room. It seemed that if a form of hood could be devised immediately over the two main sources of vitiation (the flames) it might be possible to conduct away their products at once without contamination of the body of air in the room, and yet to so proportion or control these hoods as to avoid any violent direct draught, which would make the flames unsteady.

The heated products of combustion over a flame rise vertically with great speed, and yet, because of the enormous difference in temperature between themselves and the immediately surrounding air, these upward streams remain comparatively small in diameter for a considerable height and cause but little disturbance beyond their circumferences. This is especially true of a directed stream of hot gases, such as comes from the pentane lamp cyclindrical chimney, or from the chimney of an argand burner. It thus seemed easy to carry out the plan referred to above.

To prove the point tests of the CO_2 content of a photometer room were first made over a period of 2 hours, when the room was ventilated by the ordinary method. In the center of the ceiling was a wooden shaft, extending 3 feet above the ceiling outside, and having a sectional area of about 1.3 square feet. At one side of the room near the floor an inlet air hole of 1 square foot area was cut. After a sufficient number of tests had been made under this condition of ventilation to give satisfying data as to its efficiency, the other method was tried.

In this case a hole was cut in the ceiling directly above each flame, and through these holes sections of 6-inch stovepipe flue were lowered to different heights above the flames. The intention was to find such a position as seemed to convey away all the waste products without inducing a strong disturbing draught at the flame. Also, lateral openings were cut in the flues, just below the point where they were inserted into the ceiling, and the upper lip of these lateral openings was made to protrude over the lower lip, in such a manner as to induce a slow draught inward as the hot gases rushed upwards inside

the flue. This served the purpose of removing steadily the upper layer of air in the room, which it was thought would tend to neutralize the vitiating effect upon the air of the person in the room.

It was found that a satisfactory height for the bottom of these flues was 20 inches above the top of the pentane chimney and 20 inches above the open gas flame, respectively. The doors and windows of the enveloping room were kept open so as to retain a pure air supply in the outer room, from which it found its way through the 1 square foot opening into the photometer room proper. In order to find if wind variations above the flues would cause induced draughts in such a way as to flicker the flames, an electric fan was set up, blowing a stream of air rapidly across the tops of the flues without the effect feared.

SAMPLE TEST.

The tabulated CO_2 results by the two methods are here shown:

Waste Gases Removed by Direct Ascent. Hour.	CO_2.	Waste Gases Spent into Room. Hour.	CO_2.
11:45 A.M	....	2:10 P.M	....
(Room closed.)		(Room again closed.)	
12:00 N	.055	2:25 P.M	.09
1:00 P.M	.055	3:00 P.M	.135
1:30 P.M	.060	3:25 P.M	.16
1:45 P.M	....	4:30 P.M	.20
(Room opened.)			
2:00 P.M	.055		

The question may be asked, how in practice will the vitiated air be removed from the enveloping room, for if it is not thoroughly removed it will to some extent move circuitously and be again drawn into the photometer room at the bottom? The remedy will lie in a still further extension of the vertical flue, through the roof to the outer air, where a cover must be provided for it to keep out the deposition from the atmosphere. But in this case the extension will not be of the 6-inch flue proper, but it will consist of a larger flue encircling it and overlapping it for, say, 3 inches, leaving a free annular space between the two. This will permit the hot, spent gases to continue their vertical rise and to induce still another flow inward of air through this annular space. It will serve another purpose, for if a violent wind does arise outside, tending to increase the draught up the flues, then there will be two openings in the flue above its bottom, serving to minimize the pull from the bottom of the flue and to protect the flames from draught disturbances. This would seem to prove that it is not necessary to move 36,900 cubic feet of air per hour, as was contemplated by the Committee's report.

(b) A simple check on the accuracy of a setting of the disk is possible where the Leeson comparison disk is used. It will be found that there is a position to the right of the correct setting where the right hand star will practically disappear, and another to the left where the left hand star will disappear. If the scale reading on the reader's right be called r1, then the disk be reversed and the scale reading on the reader's left be called r2, while the correct average setting of the disk for an equal illumination of both sides of it be called r3, then it can be proved that $r3 = \sqrt{r1 \times r2}$. This applies to those photometers commonly used in gas photometry whose scales are so graduated as to show directly the ratio of one compared light in terms of the other.

The theory involved in this method may be found in various discussions of the Bunsen disk, a recent one being that given by Prof. Stine, in his book on "Photometrical Measurements."

This method enables a photometrist to check his setting by observation of a field different in appearance from that which the eye had grown accustomed to, and without change of his position. It is needless to say that the photometric scale should be invisible to the eye while the readings are being made, to avoid any possible departure from a strictly unbiassed setting. A small mirror may be conveniently arranged for reflecting light on the scale after each setting is made.

A fallacious belief exists with many people that in the use of the Bunsen or the Leeson disk the right eye sees the right side of the disk and the left eye the left side of the disk simultaneously, and that judgment of the correct setting is made under this condition. It would be necessary to interpose a vertical plane surface between the lines of vision of the two eyes, with the edge of the surface close to the nose, or to train the eyes for vision at an infinite distance to accomplish this feat, unless lenses were interposed to artificially direct the rays as in a stereoscope.

As a matter of fact, the judgment is ordinarily reached by shifting the gaze of the focussed eyes rapidly from one star to another, the image of one persisting long enough to enable it to be compared with the image of the other. This action is made easier if the eye is not placed too close to the disk, but remains at such a distance, say 18 inches or 24 inches, as calls for a small angular movement of the eyeball in order to shift the gaze from one star to the other.

(c) The Committee's report suggested that a source of error in setting the disk might be removed by taking readings both from the back and the front of the photometer table. We have tried this suggestion on a photometer in regular use, where gases of different illuminating powers were used. The results will be shown by these sample comparisons, these being results obtained separately by 3 readers. It would seem that the extra work involved by the suggestion is unnecessary.

Candle Power Observed on Bar.

Front.	Back.	Front.	Back.	Front.	Back.	Front.	Back.	Front.	Back.
21.60	21.60	14.70	14.70	15.20	15.00	15.60	15.60	16.00	15.80
12.30	12.30	22.00	21.80	22.60	22.60	22.80	22.60	22.60	22.60
22.90	22.70	23.30	23.50	23.90	23.70	24.20	24.00	24.00	23.90

(d) It is clear that, if we wish an improvement in photometric methods and results throughout the country, we must place the photometrist himself somewhat higher in rank than he has been held.

(2) *Sampling the Gas to be Tested.*—The value of any analysis depends primarily upon whether or not the sample submitted for analysis be a true representative of the substance to be analyzed. Last year's Committee pointed out that, once the sample of gas was withdrawn from its regular route, it must be protected from any conditions of temperature or contact which might influence its illuminating quality on its way to the photometer room, unless such influence was intentional, as in the case where cooling coils are used. It remains to fix upon the proper place in the process of manufacture from which to draw the sample, and to discuss the best manner of obtaining a representative sample.

The question as to the "quantity" of gas manufactured is answered at the station meter, when it has reached its finished state and is ready for storage; and, in accordance with usage in measuring gases, the volume there registered is corrected to 30 inches barometric pressure, and to 60° F. temperature. It would seem that the determination of "quality" should be made at the same point; that is, at the outlet of the station meter, these two determinations to be used in calculating the manufacturing results of the works. Unless the gas is subjected to a process for further enrichment, such as by benzol at the outlet of the holders, there seems to be little virtue in taking samples from any later place along the line of manufacture than the one suggested—at the outlet of the station meter.

An ideal sample would require the continuous passing of a small fixed percentage of the station metered gas to the photometer, where it would be continuously tested and the average candle power for each hour credited to that hour. As no recording photometer of an accurate type has been devised this becomes impossible, and even in the large works the candle power is rarely determined oftener than once per hour. Yet it is possible for a considerable variation in candle power to occur in 1 hour, either in the manufacture of coal gas or of water gas, and this variation may be accidental or intentional. In order that these variations may all be included in the hourly average of candle power, there remains but one way: to store samples of gas for the unit period, usually 1 hour, then photometer the stored sample, empty the holder, and begin the storing of the next sample. This method is in practice at the Beckton works, near London, where about 60,000,000 feet of gas per day is made. Mr. Grafton told me that the method worked admirably, his holders being completely saturated, and that he considered there was no loss in illuminating power from the hour's storage. The candle power results run more uniformly, as would be expected when the irregularities of operation are thus smoothed out in the holder. It is to be preferred to a mixing or so-called averaging tank of fixed dimensions, such as is sometimes used in this country, where the stream of gas passes continuously in, through and out, and in which the effect of 1 hour's make is still likely to be traceable in the next hour's.

These small holders at Beckton were of between 5 and 10 cubic feet capacity, and each was provided with a trip valve, in case it rose too high. An inlet valve was set at a constant opening, and the outlet pipe was of large capacity for a quick discharge. An advantage of such a system is that, no matter how long the time unit in manufacture may be, the correct sampling may continue until the unit has elapsed. In a small works, where a test light was used to indicate the approximate quality of the gas, and to give warning if any wide departure from satisfactory running was evident, the time unit could be extended to 4 hours; or, for that matter, to the end of each shift.

I recall an instance in which gas was sold and delivered from one company to another at varying rates of flow, so that equal photometric intervals would have been incorrect for determining the illuminating value. A small, deep-sealed, wet meter was geared to the drum of the station meter, and the holder into which it discharged was so counterweighted as to throw but ½-inch pressure. In this way the small meter became a pump, and delivered to the sampling holder an exact proportion of the gas passing the station meter during whatever interval elapsed, usually 24 hours. The system worked well, and when the candle power of the stored sample was compared with the average of frequent photometric readings taken over the entire period of storing, remarkably close results were obtained.

Having collected a proper sample from the proper place in the system of manufacture, there still remains a variable which would prevent a just comparison between results obtained at different works, or even at the same works in different seasons. And that variable is the minimum temperature to which the test gas has been subjected. As the present endeavor is to put the photometry of gas upon a scientific basis, where just comparisons can be made, it would seem both desirable and necessary to secure control of this point of minimum temperature and eliminate it as a variable. There may be eminent examples to the contrary, as in the case of the Beckton works cited above, where the sampled gas on its way to the small storage holders is at one point exposed openly to atmospheric changes. While it cannot of a certainty be claimed that the sample in this instance is subjected to the identical temperature that the main body of the gas must meet on its way to the consumer, yet the tendency is in the same direction and the operation of the works to meet the candle power requirements at city testing stations is thus, through its works' readings, automatically guarded against the variation in illuminating value, which might be expected through change of season or weather, after the gas leaves the station meters. In such a case, however, it is evident that the best manufacturing results will be obtained in the most favorable weather, or in the most favorable climates. And this, as above stated, vitiates just comparisons.

If, on the other hand, minimum temperature control is had by means of cooling coils, the question then arises, "What temperature shall be selected as the normal for all comparisons?" Would not 60° F. seem to be the desirable selection, thus making the correction for both quality and quantity conform to the same standard? In the process of manufacture it will usually be possible, summer or winter, to preserve the gas at or above that temperature (60°) throughout the system up to the meters. If the cooling coils be of the "down-flow" type and are properly constructed, the presence of condensation in the drip-pot at the bottom of the coil will be a clear indication that their purpose is met.

(3) *The Selection of Suitable Reference and Working Standards.*—In the report of the Committee last year, describing the different standards in current use, there seemed no doubt but that the pentane lamp came nearest to fulfilling the requirements of a reference standard for the photometry of gas. It is of the same color and order of intensity as gas flames; it is the equal of any flame standard in reproducibility; it is portable; it is easily operated; it has an international reputation and has been the subject of international comparisons; it is, in the home of its origin, sanctioned as a legal multiple successor of the parliamentary candle; it interposes no glass chimney between its light and the object illuminated.

The chief requisite of a reference standard is reproducibility. As indicating the closeness with which different lamps of English manufacture agree in this respect, I quote from the report of the Director of the British National Physical Laboratory, Dr. Glazebrook, to the English Institute of Gas Engineers, which report was also used before the Zurich Commission in 1907. Speaking of their laboratory's standard pentane lamp:

This lamp, which in all its dimensions agrees accurately with the specification and has passed the Gas Referees examination, is used in the course of ordinary laboratory test work for the purpose of standardizing other pentane lamps which are sent from time to time to be tested.

The comparisons during 1904 and 1905 between this standard and and lamps from different makers are given below, for the purpose of showing the smallness of variation occurring in different lamps made to the same specification, and also to show that the pentane lamp used for these comparisons may safely be taken as having a value of exactly 10 candles.

"Lamps which adhere rigidly to specifications agree to a greater accuracy than this," is a later statement in the same report.

Pentane Lamp.	Candle Power when Compared Against National Physical Laboratory Standard Lamp.
A	9.96
B	10.00
C	9.98
D	9.98
E	10.05
F	10.00
G	10.00
Average	10.00

Our experience with the American made lamps has not shown them to be in such close agreement as to reproducibility, but these lamps have been altered in some respects from the English design. Still, no reason exists why an American lamp, once assigned a value, shall not continue to reproduce that value so assigned, and in so doing constitute a very satisfactory reference standard. As reference standards will be expected to derive their values from the Bureau of Standards at Washington, it seems to me this Institute should recommend the adoption of the pentane lamp, with a Bureau of Standards' evaluation, as the best present reference standard for gas testing in this country.

It may be another question, however, to expect to secure the general adoption of the pentane lamp as a working standard, on account of the expense in fuel and the difficulty of its shipment, so that we should endeavor to find a cheaper standard for this purpose, bearing always in mind that it is necessary to furnish an independent fuel supply to it, and that it can be standardized as often as need be against the reference standard on hand, and that the variation in its value from atmospheric causes should be the same as with the gas flame.

Such a successful working standard is the Edgerton standard when its gas is stored in a saturated holder and maintained at approximately a uniform temperature. The holder should have a capacity of about 50 cubic feet, and the inlet and outlet pipes should be large enough for rapid filling or emptying of it. The holder being filled, the Edgerton standard is lighted and, after the proper interval in which to become heated, it is given a value for that gas only by comparison with a pentane lamp. The pentane lamp is then removed and the gas test flame swung into its place. This puts into practice the "substitution method" recommended by the Committee last year. The Edgerton need not be burned at full height between readings, thus economizing the stored gas. If the holder itself cannot be maintained at an even temperature during the use of the gas stored in it, a cooling coil at its outlet may be resorted to, with a very exact temperature control. Without such a coil, however, and where a holder and photometer were in the same room, we have found the light from the Edgerton to decrease but ¼ per cent. in 24 hours, when using coal gas stored in a 120 cubic feet holder, said holder having a bell tank to insure the minimum of water to be saturated.

(4) *The Standard Test Burner.*—Having discussed light standards, what shall we now say of the other end of the photometer?

In the list of questions sent out last year by the Committee to the larger gas companies of America was one asking what test burner was in use. Now a prime object of such meetings as these is to compare results, and to select the methods which have produced the best results; and one factor in these "results" is a photometric factor. In American photometry here are the various burners through which these results were obtained: 6 feet E. H., 7 feet E. H., 8 feet E. H., 7 feet L. P. Bray, 8 feet H. P. Bray, 8 feet L. P. Union Jet Bray, Laubach & Hilpert E. H. No. 5 Union Jet Bray, 6 feet L. P. Bray Special, 6 feet Sugg Table Top; and among the Argands, Sugg D old, Sugg D new, Sugg F, Sugg E and Metropolitan No. 2.

In the gas business we thus have definite proof that this is a free country and that the field for individual initiative has been little restricted. It is quite certain that, between the worst and the best of the burners mentioned there is a difference in efficiency of 20 per cent. This chaotic condition with regard to a standard burner through which to test gas is quite in keeping with the retention of the old candle for a standard light.

The question arises, how are we to bring order out of this chaos? It certainly is time to start about it, for it is a condition we have been cognizant of for years. There are those who think the idea of fixing upon uniform rules for the photometry of gas at this late day is rather amusing, for the reason that Wisconsin has already graduated from its use; but such a view is hasty. There are many existing contracts on a candle power basis to be finished. Many more will be made. But as to the photometric methods under which they are to be conducted, it certainly falls within the scope of an Institute like this to have a large part in determining.

In the President's address of last year we find such thoughts as these: "To so conduct the affairs of the Institute that it shall be, and be recognized as being, the authority in the United States on all questions relating to the manufacture, distribution and utilization of gas, * * * including the relations between gas companies and the city and State." And further, "It is possible, by the exercise of care and deliberation, to so place this Institute that it will be universally recogniled as an authority to which appeals may be made with confidence that scientific accuracy and perfect justice will characterize its decisions. * * * There can be no doubt that the American Gas Institute is the natural body for such recognition, which we can and must arrange to deserve and to secure." I think that at the time this sentiment was expressed every member felt an "Amen." I think the members of the Institute continue to feel that sentiment. We are thus impelled to the hope that this Institute, in furtherance of the thought expressed in the President's address, will publish a set of rules on photometry of gas.

When such a set of rules is made it will be necessary to mention a standard test burner. New York State would have thanked the American Gas Institute last year if there had been on record somewhere its convictions as to the test burners. However, what has been done has been done; it should be our care to look out for the future. Let us, therefore, reason a bit over this subject of the test burner.

When Murdoch got his first consumer, that consumer was probably rather nervous about letting what was considered a poisonous, ill-smelling, bottled explosive into his house. But he knew what he wanted, he saw that he got it, and he was willing to pay for it. And what he paid for was, in his mind, not gas—it was illumination! The demand for the product has been such that, in serving all our customers, we may have slighted the fact that what we really sold was illumination—a satisfying of a certain sense craving. Yet the ill-defined intention in the past has been right along to sell our product on this illumination basis, and that is why candle power has been specified in all contracts. It is to be noted that any one of the burners we use in this country to-day is considerably more efficient than the one Murdoch used. Had Murdoch discovered in his day a form of the Metropolitan No. 2, that is to say, a high efficiency burner for self-luminous flames, then during all these years candle power would have been based on such burners as test burners without doubt. Now that the day has arrived when we do have a self-luminous burner, constructed on scientific principles, such as the Carpenter burner, the logical action of this Institute in specifying a test burner will be to go at least so far as to designate such a type; not as a final action, but as the best which is now in sight; for the principle involved is that, in testing for illuminating power, the gas is entitled to the burner of the self-luminous type (as distinguished from the incandescent type) best suited to the gas and used in the way most favorable for the gas, provided the burner shall be one which consumers may obtain and use if they wish. It is not at all certain that the best type of such a burner has been devised even now. When the total energy supplied to such a burner is compared with the proportion of it reappearing as light, we see at once how pitifully inefficient is even the best of them. The scientific study of the Argand has resulted in achieving a complete combustion of the gas under more favorable circumstances. It has done away with the wasteful excess of air and the useless heating of unsought nitrogen.

The position is exactly analogous to that in which we now find ourselves with regard to heating value. If a gas company is to be put upon a calorific basis for testing its gases, will it be satisfied to see the determinations made upon any instrument which does not, in a proper way, drain the last heat unit from the sample submitted? Why do we not specify, for the testing of calorific value, the form of water heater in common use, costing about $7? Do we expect the consumer to purchase a Junker calorimeter for something over $200, upon which to heat his shaving water in the morning? Certainly not. Scientific tests are made with scientific instruments. The Junker calorimeter is a scientific instrument, and because we know from computation just what the heating value of a gas should be, we are able to rate its efficiency.

The Carpenter burner is also a scientific instrument, but unfortunately no man has computed just what amount of light is due from a given expenditure of energy in the form of gas, and consequently we are not able as yet to rate the efficiency of this burner. Shall we, for this reason, refuse to use it, and hold instead to the open flame burner—the twin sister of the $7 water heater? That would be preposterous.

It is stated by authorities on the subject that the Metropolitan No. 2 burner, commonly known as the Carpenter, is suited for testing gases up to 20 candles. It is not improbable that a burner suitable for the testing of carburetted water gases of a higher illuminating value would be somewhat differently proportioned in its air supplies. Indeed, there is a burner on the market which differs from the Metropolitan No. 2 in having one shutter which regulates the supply of air, both to the exterior and to the interior of the flame, and whose fixed apertures are of such dimension as to give higher values for the richer gases than does the No. 2. This burner is called the Parliamentary, and was devised by Mr. Walter Grafton. As long as contracts for the supply of gas are to be based on candle power requirements, in which there is a tacit understanding that horizontal candle power is meant, it would seem that, in prescribing a uniform test burner, the type just mentioned should be specified. There should be tests made to find if a burner is not possible in which both air supplies are capable of such regulation as would, for the type of burner specified, give a maximum efficiency for the usual range of illuminating gases.

(5.) *The Future of Photometry as Applied to Gas in America.*—America is the land of raw materials, wasted by-products, and, therefore, of opportunity. Numerous are the fortunes which have been built upon the utilization of what was formerly wasted. If it is wrong to waste a certain percentage of such raw materials as can be reproduced, as in the case of agricultural products, it would then seem to be positively criminal to waste those stored raw materials which cannot be reproduced, such as coal. If coal is a natural resource, then so is the gas that results from coal. And if one foot of gas properly utilized will produce a certain effect, is there not a guilty waste when 5 feet are spent in producing it?

The effect we have in mind is illuminative effect. In the future we shall not ask to look directly at a light source and measure its initial rays; we shall ask that those rays fall upon certain objects, first, and then come, reflected from those objects, to our eyes. If the reflected light is sufficient the objects are illuminated properly, and this shall be our inquiry.

It is not the naked sunlight we let fall upon our printed page, much less do we measure its direct rays. It is the northern exposure we seek, and the diffused rays that filter down upon our page are quite sufficient for our purpose. To that extraordinary fifth sense—our sight—less light would be starvation, and more light would be stupefaction; so that as time goes on the keen competition will be to produce the uniform diffused north light in an artificial way, in the truest sense to attempt in our homes and buildings to turn night into day, in so far as we need more day to accomplish our several tasks. This presupposes at once a system of indirect lighting, which means that much of our photometry will become illuminometry.

Once a beginning is made in measuring illumination—the effect, not the candle power, the cause—we shall fall away from all quarrels as to whether a light from gas is given through a flat flame, an Argand or a mantle burner. We shall adopt the burner and the method which, while giving complete satisfaction to the consumer, shall be most economical to us. This at present points to the use of mantle burners and indicates the first conservation of our energy.

Two thoughts follow the above conclusion and indicate the direction our investigations should take in the lighting field of the gas industry: (1) We should study the placing and the directing of our lighting energy in order to produce a required illumination at the least cost. This is illuminating engineering. (2) We should study the quality and form of mantles; and the conforming of mantle shapes to flame shapes. And here we find a continued use for our elderly handmaiden, photometry. In this connection it is pertinent to remark that the Zürich Commission, referred to earlier, is not simply a photometric commission, but it is an incandescent photometric commission.

Should not we, as a Gas Institute, have a committee working along these lines of investigation, as is done in foreign countries? And should not we now make sure that we have representatives at the next International Commission meeting in Zürich, July, 1910, charged with bringing home to this Institute the beneficial results of their contact and exchange of thought with the best men in Europe on these subjects?

When we look at the "Proceedings" of this Institute for the years 1906 and 1907, and listen to the report of the Technical Committee, dealing with the unit of light at this current meeting, we realize that in matters photometric we have not remained still. Progress has been made. There comes to mind, also, the very able paper presented by a visitor, Mr. V. R. Lansingh, at the Chicago convention, in which he suggested a line of action for the Institute, in the matter of standardization of incandescent mantles. Unfortunately, at the time the

Institute was not prepared to act. It was, of course, necessary to put ourselves on record in things primary and fundamental before starting upon the more complex questions suggested above. When shall we take them up?

Street Lighting: Fixtures and Illuminants.[1]

[A paper read by H. THURSTON OWENS at the Philadelphia Convention of the Illuminating Engineering Society.]

"The street lamp post is certainly a prominent object, but as a matter of fact nobody cares what its appearance is like, except perhaps the select few, who devote the greater part of their time to grumbling in general."—NORTON H. HUMPHRYS, London, 1894.

In the majority of cases the above statement illustrates the conditions in this country to day, and, strange to say, the indifference is found among engineers as well as laymen; in fact, the former have denied having any interest in either the appearance or the type of illuminant, stating that even illumination was the chief desideratum in street lighting. My view of the matter is that the illuminating engineer is the one pre-eminently qualified to insure that these very matters are properly taken care of. Fortunately there is a growing popular interest in the subject, and the importance of having fixtures and illuminants which are uniform is apparent to everyone who has investigated the matter.

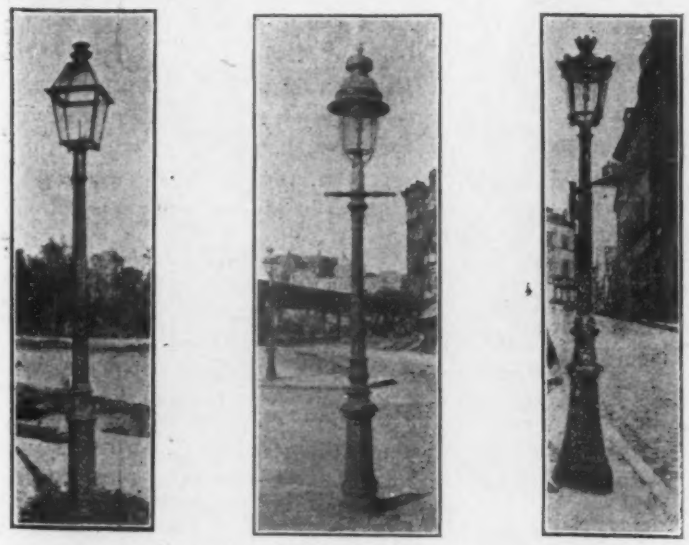
In the larger cities of this country the class of street lighting may be divided into 5 distinct groups, and each must be handled along separate lines, as follows:

1. Retail business districts.
2. Wholesale business districts.
3. Residence streets in residence districts.
4. Prominent thoroughfares in residence districts.
5. Outlying country roads.

The illuminants which are available for this purpose at the present time are of three types: Electric arcs, electric incandescent and mantle lamps, gas or naphtha. Only those used for regular public lighting are considered, and their development has been briefly as follows:

Gas and Naphtha Lamps.—The oldest and most numerous are the gas lamps; and the open flame type, equipped with square lanterns, shown in Fig. 1, was until recently that in general use. These have been gradually superseded by the mantle type, shown in Fig. 2, and this has become the standard gas lamp for the lighting of residence streets. Mantle naphtha lamps are equal to those of the gas type in efficiency and have the great advantage of being self-contained units. The mantle gas lamp used in Paris and Brussels is illustrated in Fig. 3.

Incandescent Lamps.—The only other small units which we may consider is the incandescent electric lamp, and up to the present time it has been the equivalent of the open flame gas lamp rather than the mantle type, but the fixture used has not been a credit to either the industry or the municipality. Now that more efficient types of lamps are becoming available, we may hope to see them used upon fixtures similar to those shown in Figs. 2 and 3, and *located upon alternate sides of the street.*

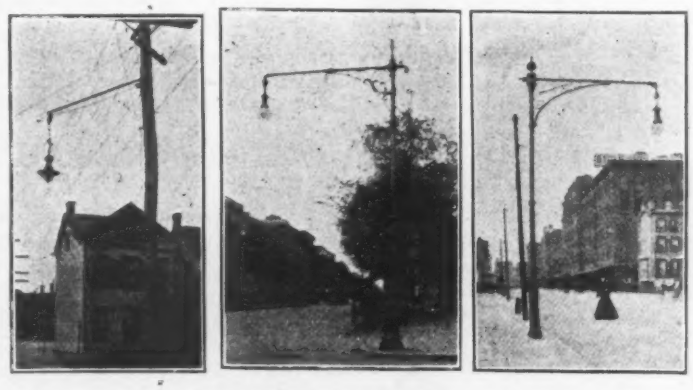


Figs. 1, 2 and 3.—Types of Gas Lamps.

[1] By permission of the author.

Arc Lamps.—The well known open arc lamp has been replaced by the inclosed type to a greater extent than open flame gas lamps have been replaced by those of the mantle type, but without the great gain in efficiency. As far as the majority of installations are concerned, its appearance is greatly against it, as will be seen by referring to Fig. 4. This type, which is known as the "Mast Arm," has seen many variations, the idea being to bring the lamp well over the street and beyond the trees. Probably the handsomest post so far designed for this purpose is shown in Fig. 5, being installed along a boulevard lined with immense elms.

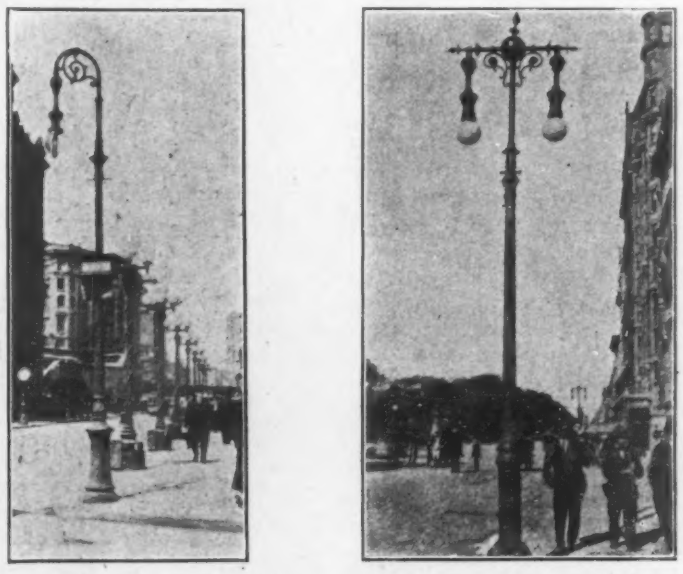
In the business portions of American cities trees are rarely to be found, whence the necessity of these long arms disappears, although large numbers of lamps are in use similar to the one shown in Fig. 6.



Figs. 4, 5 and 6.—Types of Electric Arc Lamps.

This post could well be combined with the trolley pole, also illustrated, thereby improving not only the appearance but the results as well. Unless arc lamps are equipped with dense opal globes, and hung at least 20 feet high, they should not be located more than 3 feet beyond the curb line.

Ornamental Lighting.—Street lighting installations should aim to be ornamental, but as this term is now generally used it refers more often to a spectacular installation; and many of these are now to be found somewhat similar to the incandescent lamps with frosted inclosing globes, also illustrated in Fig. 7. For this type of lamp gas is the illuminant used in Europe; while more efficient, it is not likely to become popular here, owing to the attitude of the gas interests toward this feature of the business. Arc lamps in pairs with dense opal globes are very effective for ornamental lighting, as the white color is in very pleasing contrast to the yellow from the incandescents upon the surrounding advertising signs. One of the older installations of this type is shown in Fig. 8.



Figs. 7 and 8.—Ornamental Street Lamps.

Summary.—The lighting arrangements for the various districts with the illuminants at hand may be summed up as follows:

1. *Retail Business Districts.*—In the retail business districts overhead trolleys are usually to be found and, in order that there may be unnecessary duplication of poles and that the appearance of those

in use may be materially improved, a combination trolley and light pole should be used. Another advantage of this system is there will be a sufficient number of poles at hand ready for use should it be found desirable to increase the number of lamps. Where the underground trolley system has been installed the types of lamps which can be used successfully vary greatly, and the type is usually determined by the expense involved. The lamps should be hung from 15 to 20 feet above the street, should be equipped with frosted or dense opal globes, and when so equipped have a maximum candle power of not over 400. The larger the candle power the higher up the lamp should be placed.

2. *Wholesale Business Districts.*—Arc lamps will be found the most satisfactory for lighting these districts, for two reasons: First, heavy trucking makes it essential that the posts be as few in number as possible, and, therefore, large units must be used; second, that the excellent reflection obtained from business buildings greatly aids the distribution.

3. *Residence Streets.*—The unit should not be larger than 60-candle power, placed upon posts not more than 12 feet above the sidewalk, and located upon alternate sides of the street. This means that mantle gas, mantle naphtha or electric incandescent can be used.

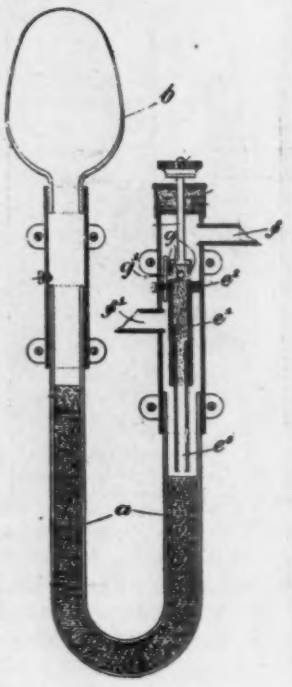
4. *Prominent Thoroughfares in Residence Districts.*—Arc lamps should be placed upon street intersections at alternate corners and not more than 300 feet apart. In case these streets are lined with trees posts should be of the mast-arm type, the arm being long enough to bring the lamp beyond the line of the trees; and, if the traffic is very heavy, additional light should be furnished by means of additional arc lamps or by small units. The type of lamp to be used for this additional lighting can only be determined by each individual case; but, as a rule, the small unit for local lighting makes the most satisfactory combination.

5. *Outlying Districts.*—Owing to the expense entailed it is impossible to obtain uniform illumination upon outlying thoroughfares. Therefore, it does not greatly matter which type of lamp is selected, provided it is placed on alternate sides of the street. The selection of the illuminant here will depend greatly upon the additional commercial business which may be obtained, which is the principal reason why arcs are so often used for this purpose, not their superiority.

The question of breakage is often brought up as an argument against costly street lighting fixtures, but, as a matter of fact, as the appearance improves, willful destruction decreases: and the respect for handsome fixtures will be enhanced if their use for other purposes, such as advertising, be prohibited. The architect's designs of lamp posts, such as those used to adorn the entrances of buildings, cannot be taken as models for street lighting; those who contend that art commissions have the ability to cope with the matter would do well to investigate installations having their stamp of approval. Undoubtedly, therefore, it is the business of the illuminating engineer to see that the designs are dignified and artistic, as well as efficient.

The Horne Thermostatic Device.

Mr. C. H. Horne, Finsbury Park, London, recently secured British Letters Patent (No. 23,016) on a thermostatic device for controlling the supply of gas to heaters, which, at this distance, looks to have a good future.



The theory of the invention is concerned with the arrangement of the by-pass, which is disposed within the thermostatic so that it is readily adjustable through a set-screw in the regular method. Referring to the drawing: The gas passes on to a heater by the route of tube *f*, holes, *g*, and tubes e^1, e^2 and f^1. According to the set given in the illustration, the holes, *g*, are fully uncovered and, therefore, the maximum supply of gas can pass to the heater. When the maximum temperature desired has been obtained, the gas supply can be reduced to what is required to maintain that temperature, by screwing down the tube, e^1, till the holes, *g*, are partially closed by the plug, e^3. Should this temperature be afterwards at any time exceeded, the vapor in *b* will expand, forcing up the sealing liquid in *a* till the tube, e^3, is sealed. Gas can then only pass to the heater through the by-pass g^1, which passes through the plug, e^3, thus directly connecting the tubes *f* and f^1. If desired, the by-pass, g^1, can be regulated by means of the set-screw shown in the drawing.

Loss of Fuel Weight in a Freshly Charged Producer.

[Read by Mr. N. T. Harrington, Lansing, Mich., at the First Meeting, Gas Power Section, Am. Soc. Mech. Engrs.]

1. The object of the test was to determine the relation between the coal fired and that actually consumed during the first few hours of operation, after completely filling the producer with a new charge of fresh coal. The apparatus used was a suction gas producer, with gas engine arranged as shown in sectional drawing in Fig 1.

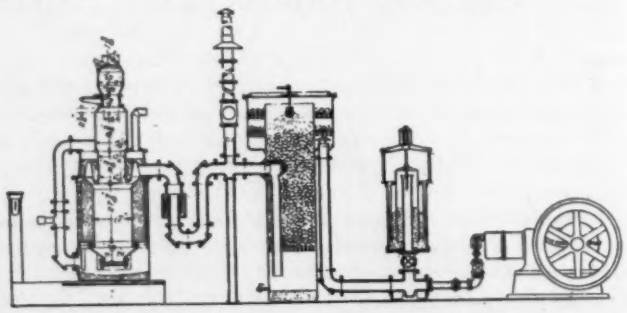


Fig. 1.—Sectional Drawing of Suction Gas Producer and Gas Engine Shown Below.

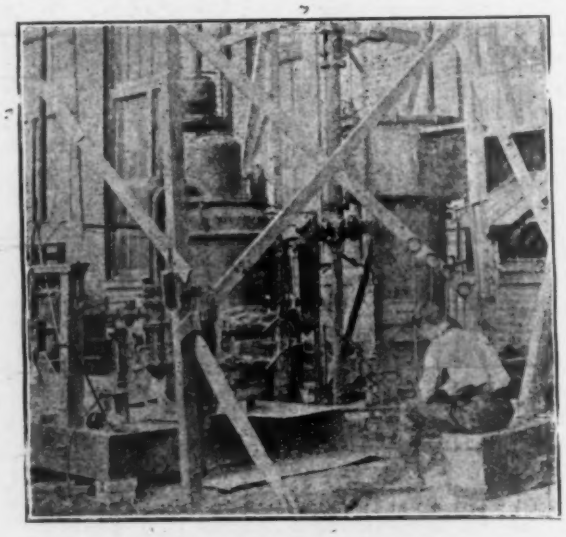


Fig. 2.—Suction Gas Producer and Gas Engine.

2. The generator shell was mounted on platform scales, that the loss in weight due to combustion might be read directly. Its gas delivery pipe was connected to the scrubber by means of a water seal to allow free movement of the generator with the platform of the scales. All connections were flexible. A prony brake was used on the engine and the load was kept as constant as possible.

3. The coal was analyzed from the pile, and from samples taken as fired during the actual test. The ash as drawn from the producer, and the salvage as returned to the producer, were also sampled and analyzed. The gas was analyzed every hour. The final charge withdrawn from the producer at the end of the run was analyzed to show the increase in the amount of ash.

4. The test was started by weighing the producer empty and clean. The fire was then started and the producer filled with fresh coal, after which its weight was again taken. After blowing hot with compressed air to obtain good gas, the fire was poked sufficiently to insure a compact fuel bed and the producer again filled. The engine was then started and the weight of the generator taken simultaneously.

5. Throughout the run all fresh coal added to the producer, and the ash and salvage taken from the producers, were weighed on separate scales. The fire was cleaned and the producer refilled every 3½ hours. The loss in weight of the fuel in the producer and the brake load on the engine were noted every 15 minutes. All weighings of producer and charge were so made and calculated that the consumption of combustible could be recorded every 15 minutes, cor-

rection being made for the ash and salvage drawn from the producer and the salvage returned to the producer.

6. The water in the vaporizer, and the water in the seal between the generator and scrubber, were kept at constant levels.

7. At the end of the run the fire was cleaned and the producer filled, after which engine and producer were shut down and the final weight of producer and charge taken immediately. The entire charge, with the exception of the clinkers sticking to the walls, was then withdrawn from the producer and quenched, and the producer again weighed to determine the amount of clinker sticking to the walls. The clinkers were then removed, pulverized and mixed with the rest of the charge. The whole was then sampled and analyzed, by which means it was possible to strike a balance between what was put into the producer and what was taken out.

8. Fig. 3 shows the relation between the combustible burned dur-

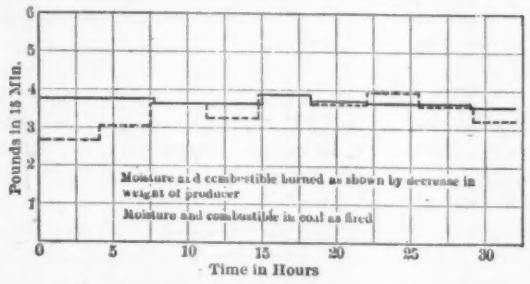

Pounds in 15 Min.
Moisture and combustible burned as shown by decrease in weight of producer
Moisture and combustible in coal as fired
Time in Hours

Fig. 3.—Record of Combustible and Moisture.

ing the nine periods of the tests, corresponding to the nine times the fire was cleaned and producer filled and the combustible fired to the producers during the same periods. Figures for combustible were taken to include moisture. The combustible burned was determined by the loss in weight shown by the scales under the generator. The combustible fired was determined by deducting the ash contents from the weight of coal as fired and weighed separately on small scales.

9. While these two curves do not show the actual amounts of coal fired and consumed, it may be assumed that the ordinates are directly proportional.

10. Fig. 4 shows the actual loss in weight of the charge in the producer by periods.

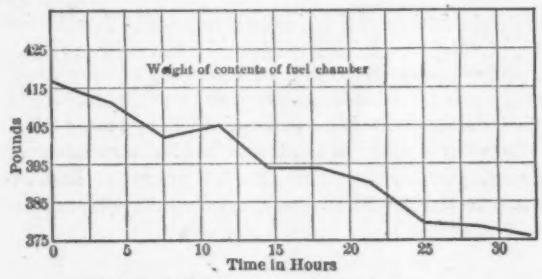


Fig. 4.—Record of Loss of Weight of Charge

11. Care was taken that the fire was clean and without cavities at the times of filling and that no arches or stoppages occurred in the fire at any time during the test. At the end of the run the fire was poked vigorously from the top to determine how much additional coal could be jammed into the producer. Only 10 pounds more could be added, and it is possible that this slight settling of the coal was due to a portion of the charge being forced up into the gas ring.

12. The difference of 40 pounds between the weight of the charge at the beginning and end of the run is to be attributed to the burning out of the carbon and volatiles from the lumps of coal, leaving the laminated ash structure to occupy about the same space as the original lumps of coal, but increasing the ash contents of the mass.

13. For a short run with a fresh fire, it would seem that the coal fired to the producer does not represent the actual coal consumed and that in a 30-hour run it may be as much as 8 per cent. too low.

General Data.

Producer—

Duration of test	32	hours.
Diameter of fuel body	16	inches.
Area of section of fuel body	1.395	square feet.
Weight of generator	3,491	pounds.

Engine.—Single cylinder, single acting, 4-cycle.

Diameter cylinder	7⅞ inches.
Stroke	10½ inches.
R.P.M	380
Average B.H.P. developed	1.26

Coal Analysis.

	Percentage Coal as Fired,	Percentage Final Charge Drawn from Producer.	Percentage Ash.
Moisture	2.58	....	.10
Volatile carbon	5.47	2.72	1.68
Fixed carbon	74.09	75.49	28.42
Ash	17.86	21.79	69.80

Results.

Weight of charge in producer at the time of starting run, pounds	416	Loss of combustible and moisture by weight during run, pounds	471.15
Weight of coal added during run, pounds	506	Weight of ash withdrawn during run, pounds	76 75
Total	922	Weight of final charge withdrawn from generator, pounds	376 00
Error	1.9		
Total, pounds	923.9	Total, pounds	923 90

Weight of charge in generator at beginning of run, pounds	416
Weight of final charge withdrawn from producer, pounds	376
Loss in weight of charge due to fire loading up with ash, pounds	40

Special English Correspondence.

Communicated by Norton H. Humphrys.

Salisbury, England, October 9th, 1908.

An Airship Explosion—The Late Sir George T. Livesey—Commercial Sections.

Some attention was excited in August last by the explosion of a balloon used in connection with an airship exhibit at the Franco-British Exhibition. The cause appeared to be mysterious insomuch as no naked lights were allowed in the tent containing the machine, nor was there any evidence of such being in use at the time of the catastrophe, which was unfortunately attended with fatal results. In view of the fact that coal gas is generally used in connection with balloons, there were not wanting suggestions to the effect that the occurrence was brought about by some unknown propensity on the part of that largely used agent, towards spontaneous combustion. Full inquiry has made the facts perfectly clear, and it is desirable that the truth should be generally known, for two reasons. One is that the association of coal gas with the affair is entirely gratuitous, seeing that it was not used at all, and does not figure in the matter, and the other is that electric fans or ventilating appliances are most dangerous in all cases where an explosive atmosphere may obtain. It would appear that the exhibit was more of the nature of a life sized model than a practical working article. It was contained in a tent, lighted by electric glow lamps and ventilated by means of electrically driven fans, thus removing all necessity for naked lights, and presumably of all risk of igniting agency. That this confidence was entirely misplaced is proved by the occurrence which may be summed up as being due to a mistaken faith in the capabilities of electricity as a safety lamp. Some time ago I alluded to the use of safety lamps (so called) that afford no security, and it is now evident that electric appliances should be placed in that category, because wherever electric contacts are made there is a risk of "sparking." The balloon used in connection with the airship was of a cigarlike shape, 75 feet long by 16 feet in diameter at the center, capable of containing 10,000 cubic feet, and was nominally charged with hydrogen. But this gas, as is well known, would not remain in the containing envelope for any considerable length of time. Every day there was an appreciable loss, and as hydrogen is a costly gas (some 10 times the cost of coal gas), the practice was adopted of making up for the deficit with air. To secure this result the neck of the balloon was held over the outlet of an electrically driven fan. On the day in question this procedure had been going on for half an hour. An electrical engineer gave evidence that the fan was of a kind that frequently sparks at the switch. Now every tyro in chemistry knows that it is not a difficult matter to get an explosive mixture with hydrogen and air. The owner of the airship seemed to think that the proceeding was safe, because of the difference in specific gravity, and that the two gases would stratify in distinct layers, just like oil and water, and it is surprising that he should have been under any misapprehension in respect to such an elementary matter. It is difficult to characterize the occurrence as anything less than ignorant recklessness, and had the advice of a qualified gas engineer been taken it would have been avoided. The chief lesson to be drawn is that electrically driven fans should never be used in an explosive or combustible atmosphere, as under such circumstances they are quite as dangerous as naked lights.

The death of Sir George T. Livesey, which occurred on Sunday last, is almost like the closing of a chapter in the history of our industry. As time goes on the number of those who remember or took part in the stirring times comprised between the period 1850–1880, dwindles to a very small proportion, and the new generation have no personal recollection of the pioneering and foundation work done at that time, the results of which are apparent in the position of our industry to-day. The gas manager of 50 years ago was essentially a man of many parts. Technical education or training, as now understood, he had none, for nothing of the sort was available. Classes for instruction in chemistry or engineering drawing were in existence in some of our principal towns, but simply dealt with general and elementary matter But just as hardy plants flourish upon poor soil, so these disadvantages brought out several engineers who have left their trade mark on the gas industry, and of these the gentleman whose death we now deplore was a most notable example. Sir George Livesey entered the service of the South Metropolitan Gas Company at the early age of 14 years, and the connection was only severed by his decease at the age of 74; 60 years of genuine, honest labor and 60 eventful years, both for the particular undertaking and for the industry at large. It would not be good form to attempt to supplement the numerous details that have already appeared both in the technical and in the public press, and it would not be possible to present an adequate resume of them within the space at disposal. An idea of the work accomplished in 6 decades cannot be properly expressed in a few lines. But I would like to remark that George Livesey, the administrator, has to some extent eclipsed the fame of George Livesey, the gas engineer. The younger members of the profession know him only as the head of the second (in point of size) London gas company, as a skilled expert and parliamentary witness, and as an ardent and successful worker at reconciling the rights of the three principal parties concerned in gas, or for that matter, in any commercial undertaking, the consumer, the worker and the shareholder. They have not failed to appreciate his boldness, originality and determination. But older members will recall the times when, as the Engineer of the South Metropolitan Gas Company, these qualities were directed, and with no less successful result, to various problems connected with the manufacture, purification and storage of gas. There was scarcely any department of the works that escaped his attention, from the retort to the gasholder. He was a regular attendant both at the Gas Institute and the District Association meetings, frequently presenting contributions to the proceedings and taking active part in the discussions. And he always retained his connection, although of necessity his attendance was less regular in more recent years. Only last year he came before the Southern District Association of Gas Engineers with a paper on "Profit-sharing and Copartnership in Gas Works." He read the paper and replied to the discussion without exhibiting the slightest indication of the failings common to advancing age. But at the earlier time referred to he studied and improved amongst other things the hydraulic main and the purification of gas by liquid. In connection with gasholders his name will be always remembered as the pioneer of several improvements that had the effect of largely reducing the cost. His ideas were embodied in the 12-million foot gasholder at Greenwich, which was for many years the largest in the world. While these things were in progress the gates at Old Kent Road or at Greenwich were always open to the profession. Any manager requiring information or interested in others of the questions in hand was sure of a genial welcome and personal attention, with every encouragement to see and hear everything, and without any of the exclusiveness that was the general rule, rather than otherwise, at the larger gas works in the country.

The autumn meetings of the District Associations are now for the most part events of the past. A notable feature, if not a dominant note throughout the proceedings, is the commercial side of the gas industry. "Hoc Pretiam" has been prominent in the inaugural addresses, the papers submitted, and the discussions, and those Associations that are not already running commercial sections are considering the desirability of doing so. Looking at the enormous annual expenditure, amounting to several millions sterling, for which the managers of gas undertakings are more or less directly responsible, there is nothing surprising in this position of affairs. The gas managers of to-day realizes that while he is looking after the pence in the retort house and purifying sheds, the pounds may be *not* taking care of themselves in the matter of the purchase of materials, and the sale of residuals. He finds the necessity for a better and more intimate knowledge of the current position in the coal, the metal and the fireclay markets, and of what others are doing in regard to the sales of coke, tar and sulphate of ammonia, than can be gained by casual observation of technical periodicals, price lists, etc., and the commercial section is simply an endeavor to supply the want. But there is this difference between the technical and the commercial work of the Association: The technical portion is of interest and direct benefit to the members only, although it is now generally recognized by directors and stockholders, that the advancement of technical knowledge carries benefits which, through and by way of the engineer, extend into and permeate the whole of the interests concerned. The Gas Managers' Association is and has been a powerful incentive towards cheaper gas and better dividends. But the position is reversed, so far as commercial work is concerned. The financiers of the gas undertaking secure the immediate benefit, while the engineer and manager, if he profits at all, only does so in an indirect and roundabout way. There have been doubts as to who should pay the Association dues, the manager or his employers, and as a general rule the members prefer not to raise the question, but to pay fees and travelling expenses out of their own pockets. But there can be no question of this kind about the commercial section. It cannot be successfully worked without considerable outlay for postage, stationery and clerical labor, more, in fact, than can be covered by the funds of the Association. A special contribution is necessary for this purpose, and if the directors of the undertaking do not care to pay it, there is no reason why the manager should do so. The commercial section is run as a part of the business of the Association, and as a rule participants in its advantages are confined to those concerns whose engineers are represented on the list of membership. The section is under the full control of the General Committee, but its affairs are managed, subject to this condition, by a special committee, and entirely apart from the general business. The chief feature is the collection of information, tabulation of the same, and issued to the members, and it is, of course, understood that all figures are "private and confidential." In addition to the question of prices, the sections are taking up the subject of advertising in all its various forms of soliciting business, and any subject that might be included under the title.

Items of Interest
FROM VARIOUS LOCALITIES.

At the annual meeting of the Massachusetts Gas Companies, Messrs. C. M. Weld, A. Straus, Robert Winsor, F. E. Snow and C. A. Stone were re-elected trustees, to serve for 2 years.

We regret to be called upon to chronicle the death of Mr. John T. Sweeney, who passed away at his home in Marlboro, Mass., the afternoon of the 9th inst. He was in his 30th year and had been in the counting room of the Marlboro Gas Company for quite a while, serving it as head bookkeeper.

The Board of Gas and Electric Light Commissioners of Massachusetts, in deciding the case argued by certain residents of Chicopee, Mass., against the Chicopee Gas Light Company, urging a reduction in the gas rate, was decided adversly to the Company, a reduction to $1.35 per 1,000 in the net rate having been ordered. Although the main result—a decrease of 5 cents merely—is seemingly small, nevertheless the decreers findings, in respect of the nature of differential rates, are sufficiently important to warrant the reproduction of the finding in full. It is as follows:

"This is a complaint in writing under Section 34 of Chapter 121 of the Revised Laws by more than 20 customers of the Chicopee Gas Light Company relative to the price for gas supplied by said Company. The hearings were in Chicopee, and the petitioners and Company were represented by counsel. The present gross price to commercial customers is $1.70 per 1,000 feet, with the following scale of discounts on monthly bills: For consumption up to 1,900 cubic feet, 30 cents; 2,900 cubic feet, 35 cents; 5,900 cubic feet, 40 cents; 30,000 cubic feet, 45 cents; 39,900 cubic feet, 50 cents; 49,900 cubic feet, 55 cents; 59,900 cubic feet, 60 cents; 74,900 cubic feet, 65 cents; 75,000 cubic feet, 70 cents. Under this schedule, which has been in force since July 1, 1906, it will be seen that the maximum net price is $1.40. The average price received for the total amount sold during the year ending June 30, 1908, was $1.32. It was urged at the hearing that the Company's operating expenses were needlessly high, that its actual profits exceeded those disclosed by the annual returns to this Board, and that the prices charged compared unfavorably with those prevailin in the neighboring municipalities of Springfield, Holyoke

and Westfield. There is nothing in the testimony or the books and records of the Company which shows that it is making profits which are not disclosed in its returns. Taking into account the conditions under which the Company must operate and without attempting to indorse every individual item of its expense, the Board is of the opinion that as a whole its operating and maintainance charges are not unreasonably high. It is true, as the petitioners contend, that prices prevailing in other communities are competent evidence with respect to the reasonable price in Chicopee. But the weight of such evidence must depend almost entirely on the extent to which conditions are alike in the companies compared, and this is rarely so great as to make them the controlling factor in fixing the price at which the company ought to sell its product, although it may have an important bearing on its methods and policies. A serious criticism of the Company's charges was the claim of their manifest unfairness to the average consumer, due to the peculiar system of differentials in force. In almost any lighting company the possible economies and resulting advantages to the public are largely dependent upon the volume of the output, and the management is bound to avail itself of every reasonable opportunity for increasing its business. With this end in view, its schedule of rates contrived for the purpose of selling gas to do work otherwise more economically done with other materials, and effective to this end, may under some conditions and in some companies, furnish very strong grounds for a differential rate. It should be clear, however, that the rate made is not a losing one, that it will increase the Company's profits as well as the volume of its business. Differentials of this kind are quite different in character and afford no justification for that practice which seeks to charge a large consumer one price and a small consumer a higher price, merely because of a difference in size. The objections to the differential system of rates employed by this Company are the more obvious, as the concessions from the maximum price appear to be based primarily and solely on the relative size of the Company's customers. The schedule shows a wide range of net price, from $1.40 to $1, apparently dependent entirely upon the amount consumed in a month. No adequate justification for a differential on such a basis was presented at the hearing. So far as the schedule stands without other reasons for its support it appears to be contrary to that sound public policy by which the relations of a corporation of this character to the public are to be determined. The failure of the Company to secure reasonable return from its business cannot be urged against a reduction in price if such failure be due to unreasonably low rates to some particular class or classes of its customers. Differentials may often be corrected and gradually eliminated by reductions in the maximum net rate."

At the annual meeting of the shareholders in the Mansfield (O.) Gas Light Company the officers elected were: Directors, C. W. Upson, W. C. Hedges, J. E. Upson, J. P. Seward, Joseph S. Hedges, H. M. Weaver and Dr. J. S. Hedges; President, C. W. Upson; Vice-President, Dr. J. S. Hedges; Treasurer, J. E. Upson; Secretary and Superintendent, W. C. Hedges. These gentlemen are also in control of the affairs of the Mansfield Electric Light and Power Company.

We may bid a final farewell to the Palmyra (N. Y.) Gas Light Company, the Supreme Court having recently granted a motion and order asked for by the Hon. Charles McLouth, selling the affairs of the Company under liquidation.

"B. F. M.," writing from Youngstown, O., under date of the 16th inst., inclosed the following: "Two workmen in the employ of the Consolidated Gas and Electric Company, while working at a point in East Federal street opposite the Youngstown Ice Company's warehouse, narrowly escaped drowning through a break in the water main. A gang was engaged in digging a ditch in which to place a service pipe, when without the slightest warning the exposed water main burst, the fluid escaping with such speed and volume that two diggers close to the spirting stream were unable to climb the bank, and were thrown unconscious to the bed of the ditch. They were rescued with difficulty by a calker whose head was inclosed in an anti-asphyxiator. Moral, always have the asphyxiator or helmet handy when trenching even near or under a water main.

The proprietors of the Fall Riuer (Mass.) Gas Works Company have applied to the authorities to string pipes along the Slade's Ferry bridge with a view to supplying the residents of Somerset, on the opposite side of the Taunton river.

The Fitchburg (Mass.) Gas and Electric Light Company has appealed to the Massachusetts Board of Gas and Electric Light Commissioners to annul the franchise granted by the local authorities of Fitchburg to the Connecticut River Transmission Company, under which the latter might engage in the supply of electricity in the city named.

Mr. C. F. Cattell, whose headquarters are in West Chester, Pa., as almost every gas man knows, having succeeded in placing the bonds on the property, is preparing to go on with the construction work on the gas plant for Parkesburg, Pa.

A special despatch to the Des Moines (Ia.) *Register* says that the Fairfield (Ia.) Gas and Electric Company proposes to take over the city lighting and water plant, and a Committee of Councils is considering the proposition. The present plant of the city is inadequate, and the Company offers to light the streets and pump all water at the same rate that it is now costing the city to do its own work.

At a meeting of the employees of the Spokane Falls (Wash.) Gas Company held early this month, it was decided to form a club for the better acquainting of the men with each other, both as to their work and as to their times of social meeting. The Company has agreed to furnish them with a meeting place and with all the literature pertaining to the gas business that would be of benefit to them in their calling.

The new rate of gas, established by the Scranton (Pa.) Gas and Water Company last month, to become effective this month, seems to have been effective, if the results attending the work of the Company's canvassers may be accepted as an indication. Those whose bills amount to over $15 per month (the gross rate is $1 per 1,000), but not exceeding $25, are to have a discount rate of 10 instead of 5 per cent.; over $25, discount 20 instead of 10 per cent. Manager Stack reports "plenty doing" in Scranton.

Mr. Thomas Nickerson, who has been Manager of the Woonsocket (R. I.) Electric Machine and Power Company, is now in full charge of the management of the Woonsocket Gas Company's affairs.

During the year so far, or up to the first inst., to be precise, the main system of the Richmond (Va.) municipal gas works was increased by the laying of 7 miles of pipe, none of which was under 4 inches diameter.

Mr. Marc W. Comstock, of Buffalo, N. Y., has been appointed receiver under bonds of $10,000, in a civil action in the United States District Court, instituted by E. J. Bailey, of Boston, Mass., against the Genessee County Electric Light, Power and Gas Company, of Batavia, N. Y. The issue involved is the value of a $4,000 negotiable note.

"V. H.," writing from Philadelphia under date of the 18th inst., says: "Perhaps you think our gas folks at Chester in this State are not up-to-date in every respect. Well, if you do so think, kindly revise your belief, in proof whereof I say to you that the Suburban Gas Company has established an illuminating engineering division or section in alliance with its New Business department. The Company believed there was a good field in this division, and the local architects, merchants and building contractors are proving that the belief was well founded, in that the named branches of trade and art are frequently consulting with the Gas Company as to the best means of lighting old business structures and of lighting new buildings either underway or well towards the finishing points."

The authorities of Jonesboro, Ind., have granted a franchise for the right to there construct and operate a gas works to the Indiana Gas and Electric Company. It is stipulated that the Company may not charge in excess of $1 per 1,000 cubic feet, gross, or 90 cents, net, for prompt payment, within 10 days.

Mr. F. A. Schroeder, formerly in charge of the Clinton and Leominster (Mass.) properties of the Massachusetts Light and Power Company, has been made General Superintendent of the Worcester County Gas Company, with headquarters in Spencer, Mass. His predecessor at Spencer (Mr. Chas. Ennis) has arranged to accept a responsible place on the force of the L. E. Burden Company, Boston.

Things are going along at a rapid pace in connection with the development of the business of the Beaumont (Tex.) Gas Company, so says its General Manager, Mr. M. T. Walker. In addition to the placing of 5 additional miles of mains, the Company has authorized the Western Gas Construction Company to construct for it a purifying apparatus up to taking care of an output 50 per cent. greater than the present sendout.

The Market for Gas Securities.

The market figures for the week are better than those of its predecessors. Consolidated (in which there was some fairly active trading) sold as high as 146 plus, dropped off to about 144, and opened to-day (Friday) at 145 to 145¼. Another slight pool to the short side, it is averred, has been formed, but its promoters have more than an even chance to get a dose similar to the one which caused so much griping last summer.

Brooklyn Union is steady with a good demand for the Company's 5's, which are still well below their real value. The outside market is generally steady save in the case of Washington gas, which is again beyond 330. Manager Hart, at the Hotel Astor, said this morning, it would be cheap at 400, but the writer noted that Mr. Hart's headgear was of the flat "Tommy Jones" variety, with a decidedly green tinge in the coloring.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

OCTOBER 26.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share:

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated Gas Co.	$73,177,000	100	145	145¼
Central Union Gas Co.—				
1st 5's, due 1972, J. & J.	8,000,000	1,000	98	101
Equitable Gas Light Co.—				
Con. 5's, due 1932, M. & S.	1,000,000	1,000	—	105
Mutual Gas Co.	3,500,000	100	130	160
New Amsterdam Gas Co.—				
1st Con. 5's, due 1948, J. & J.	11,000,000	1,000	100	102
New York & Richmond Gas Co. (Staten Island)	1,500,000	100	37	43
1st Mtg. Gold Bds. 5 p. ct.	1,000,000	—	98	104
New York and East River—				
1st 5's, due 1944, J. & J.	3,500,000	1,000	100	105
Con. 5's, due 1945, J. & J.	1,500,000	—	97	101
Northern Union—				
1st 5's, due 1927, J. & J.	1,250,000	1,000	86	91
Standard	5,000,000	100	70	100
Preferred	5,000,000	100	100	125
1st Mtg. 5's, due 1930, M. & N.	1,500,000	1,000	100	105
The Brooklyn Union	15,000,000	1,000	138	142
1st Con. 5's, due 1948, M. & N.	15,000,000	—	91½	92
Yonkers	299,600	500	130	—
Out-of Town Companies.				
Bay State	50,000,000	50	1⅞	2
" Income Bonds	2,000,000	1,000	—	75
Binghampton Gas Works	450,000	100	—	65
" 1st Mtg. 5's	509,000	1,000	95	100
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	5	8
" " Bonds, 5's	5,250,000	1,000	63	66
Capital, Sacramento	500,000	50	—	35
Bonds (6's)	150,000	1,000	—	—
Chicago Gas Co. Guaranteed Gold Bonds	7,000,000	1,000	104	106¼
Cincinnati Gas and Electric Co.	29,500,000	100	89	90
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	92	98
Columbus (O.) Gas Lt. & Heating Co.	1,682,750	100	90½	91
Preferred	3,026,500	100	71	80
Consumers, Toronto	2,000,000	50	200	204
Consolidated, Baltimore	11,000,000	100	—	105
Mortgages, 6's	3,600,000	—	—	118
Chesapeake, 1st 6's	1,000,000	—	—	—
Equitable, 1st 6's	910,000	—	—	—
Consolidated, 1st 5's	1,490,000	—	—	112
Consolidated Gas Co. of N. J.	1,000,000	100	15	17
Con. Mtg. 5's	880,000	1,000	92	95
Bonds	75,000	—	—	100
Denver Gas and Electric	—	—	74½	75
Detroit City Gas Co	5,000,000	50	—	50
" Prior Lien 5's	4,619,000	1,000	97	100½
Detroit Gas Co., 5's	881,000	1,000	75	80
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	—	101
Essex and Hudson Gas Co.	6,500,000	—	39	40
Fort Wayne	2,000,000	—	—	—
" Bonds	2,000,000	—	55	—
Grand Rapids Gas Light Co., 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	190	200
Hudson County Gas Co., of New Jersey	10,500,000	—	112	113½
" Bonds, 5's	10,500,000	—	103	103½

Advertisers' Index.

GAS ENGINEERS. Page

Bartlett, Hayward & Co., Baltimore, Md. 741
Cruse-Kemper Co., Philadelphia, Pa. 728
Davis & Farnum Mfg. Co., Waltham, Mass. 740
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Frank D. Moses, Trenton, N. J. 742
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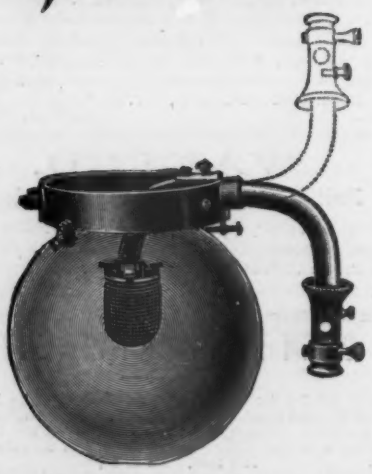

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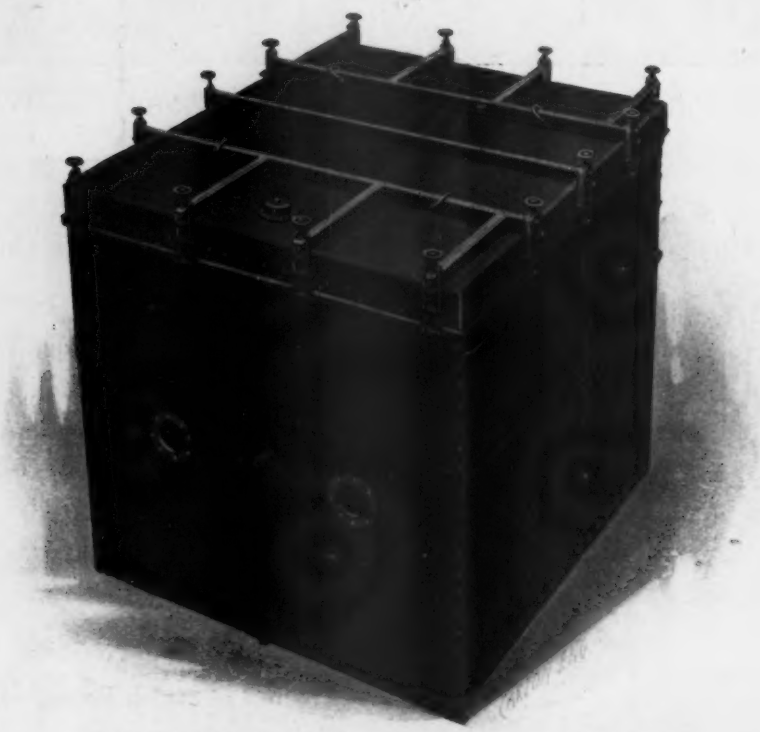

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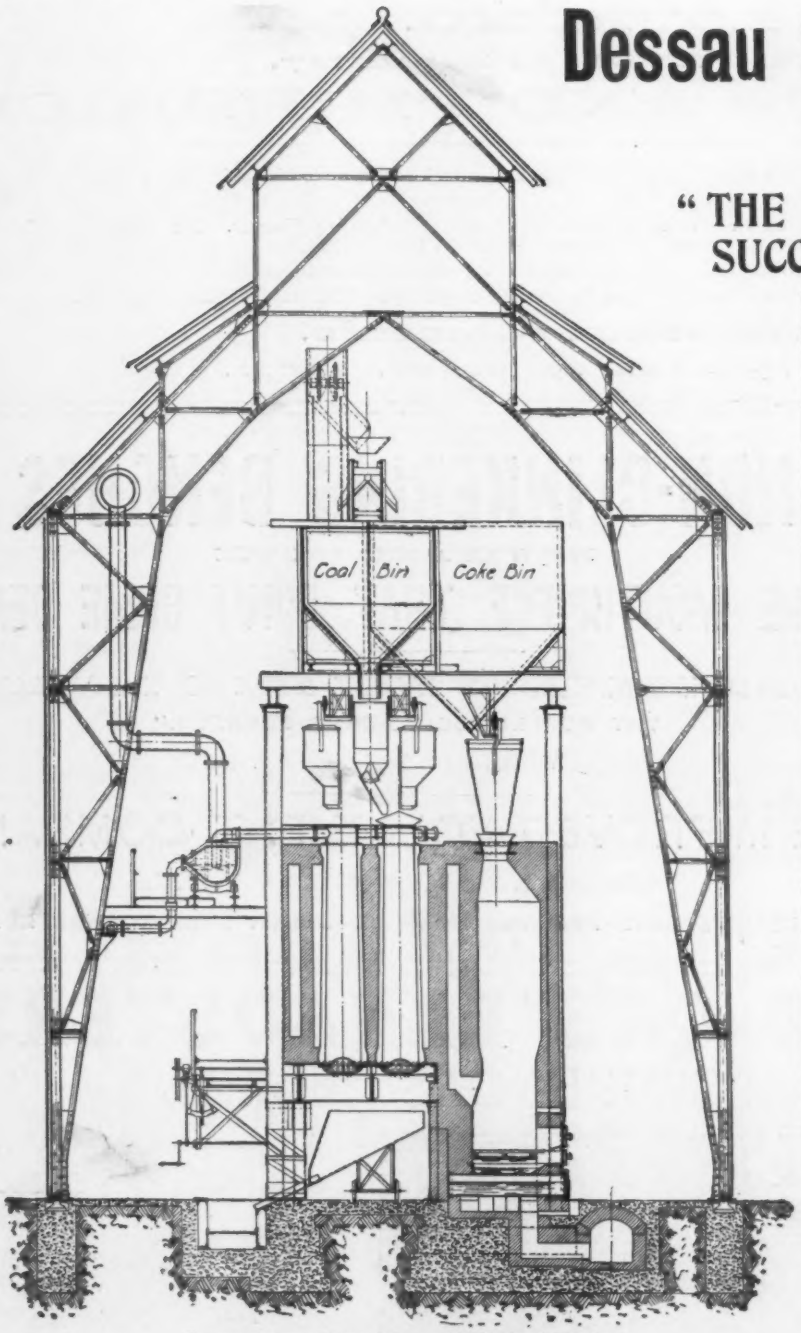

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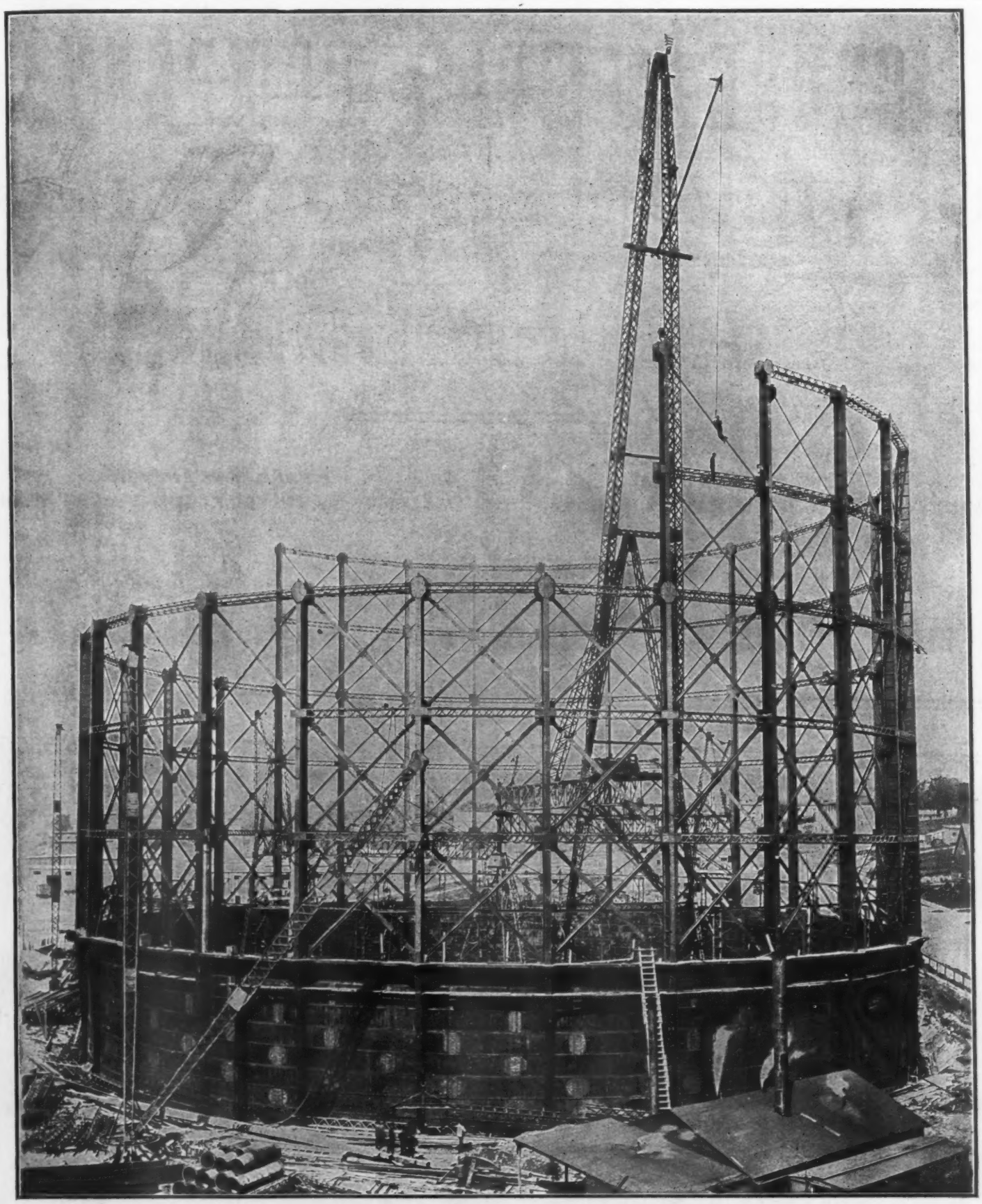

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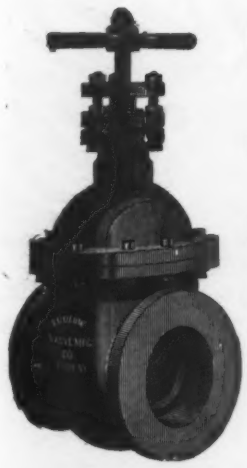

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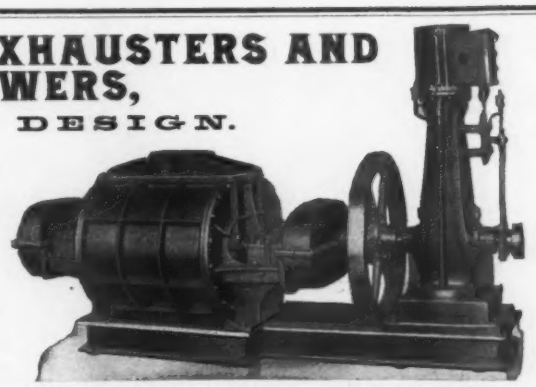

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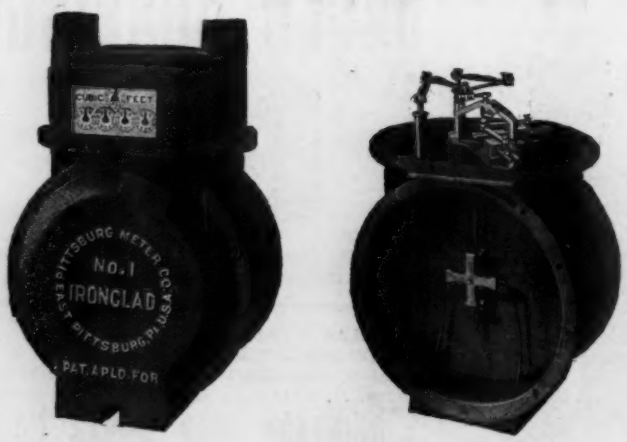

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They are extra heavy in every way, particularly at the ends, and are not cored out under the hexes. The keys have a much broader lap than the ordinary key.

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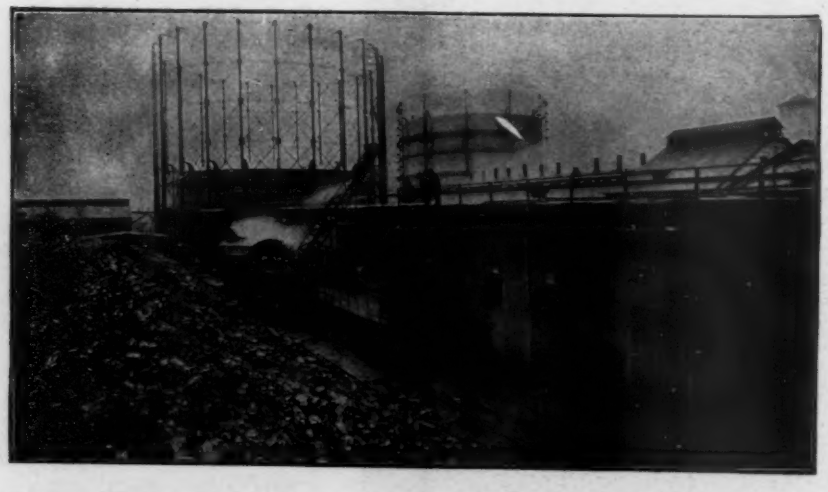

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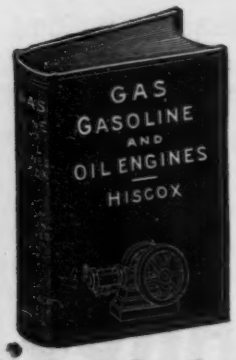

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PUBLIC LIGHTING TABLE.

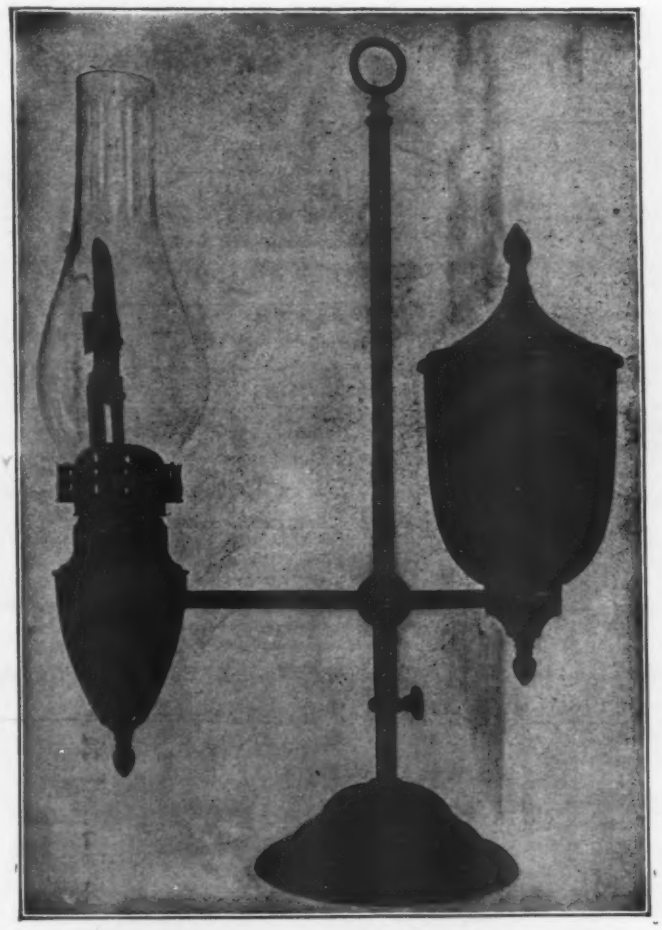
NOVEMBER, 1908.

Day of Week.	Table No. 1. FOLLOWING THE MOON. Date.	Light.	Extinguish.
Sun.	1	10.30 FM FQ	5.30 AM
Mon.	2	11.40	5.30
Tue.	3	12.50 AM	5.30
Wed.	4	2.10	5.30
Thu.	5	3.20	5.30
Fri.	6	No L.	No L.
Sat.	7	No L FM	No L.
Sun.	8	No L.	No L.
Mon.	9	5.20 PM	7.00 PM
Tue.	10	5.20	7.40
Wed.	11	5.20	8.30
Thu.	12	5.20	9.20
Fri.	13	5.20	10.20
Sat.	14	5.20	11.20
Sun.	15	5.10 LQ	12.20 AM
Mon.	16	5.10	1.10
Tue.	17	5.10	2.10
Wed.	18	5.10	3.10
Thu.	19	5.10	4.10
Fri.	20	5.10	5.50
Sat.	21	5.10	5.50
Sun.	22	5.10	6.00
Mon.	23	5.10 NM	6.00
Tue.	24	5.10	6.00
Wed.	25	5.10	6.00
Thu.	26	5.10	6.00
Fri.	27	5.10	6.00
Sat.	28	8.20	6.00
Sun.	29	9.30	6.00
Mon.	30	10.40 FQ	6.00

TOTAL HOURS DURING 1908.

By Table No. 1.

	Hrs.Min.
January	228.30
February	187.30
March	192.00
April	160.10
May	155.10
June	138.00
July	155.50
August	173.40
September	185.20
October	214.00
November	218.10
December	226.40
Total, yr.	2235.00



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10-Candle Power.

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This lamp is a perfect substitute for the 10-candle Pentane Lamp hitherto used, and has the following advantages:

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2d. It is remarkably steady. Will burn 24 hours continuously with less than 2 per cent. variation.

3d. It is much less dangerous than Pentane, which is a kind of gasolene.

4th. It is not easily affected by air currents in the photometer room.

5th. Since the lamp may burn continuously, the candle power of gas may be taken at any moment, if necessary. This insures steady illuminating power without waste of carburetting material.

6th. The first cost of the lamp brings it within the reach of even small gas works.

7th. Costs much less to maintain than a Pentane lamp or sperm candles doing the same service.

8th. Is not affected by the weather.

PUBLIC LIGHTING TABLE.

NOVEMBER, 1908.

Day of Week.	Table No. 2. NEW YORK CITY. All Night Lighting. Date.	Complete Lighting in One Hour From Time Given P. M.	Complete Extinguishing in 50 Minutes From Time Given A. M.
Sun.	1	4.37	5.17
Mon.	2	4.37	5.17
Tue.	3	4.37	5.17
Wed.	4	4.37	5.17
Thu.	5	4.27	5.27
Fri.	6	4.27	5.27
Sat.	7	4.27	5.27
Sun.	8	4.27	5.27
Mon.	9	4.27	5.27
Tue.	10	4.27	5.27
Wed.	11	4.27	5.27
Thu.	12	4.17	5.32
Fri.	13	4.17	5.32
Sat.	14	4.17	5.32
Sun.	15	4.17	5.32
Mon.	16	4.17	5.32
Tue.	17	4.17	5.32
Wed.	18	4.17	5.32
Thu.	19	4.12	5.42
Fri.	20	4.12	5.42
Sat.	21	4.12	5.42
Sun.	22	4.12	5.42
Mon.	23	4.12	5.42
Tue.	24	4.12	5.42
Wed.	25	4.12	5.42
Thu.	26	4.07	5.52
Fri.	27	4.07	5.52
Sat.	28	4.07	5.52
Sun.	29	4.07	5.52
Mon.	30	4.07	5.52

TOTAL HOURS DURING 1908.

	Hrs.Min.
January	481.50
February	329.15
March	351.50
April	341.50
May	233.05
June	218.10
July	282.55
August	254.55
September	292.25
October	420.45
November	374.30
December	411.05
	3992.35
Deduct on account of 50 min. extinguishing time	30.30
Total, yr.	3962.05

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By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

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IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

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For decorative appearance and large volume of light at a popular price to the consumer,

THE CHIC LIGHT

is practically alone in the field. Complete satisfaction to the user is its strong point.

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PRICES:

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Price, complete, clear cylinder, each, dozen lots, ... $1.35
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Peoria, Ills.
Schenectady, N. Y. (2d contract).
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Galveston, Tex. (2d contract).
Quebec, Canada.
Indianapolis, Ind. (2d contract).
Bessemer, Ala.
Waterbury, Conn. (5th contract).
Sioux Falls, S. D. (3d contract).
Philadelphia, Pa.
New Hartford, Conn.
Poughkeepsie, N.Y. (2d contract).
Nashville, Tenn.
Salisbury, Md.
Norfolk, Va. (4th contract).
Wallingford, Conn.
Richmond, Va. (2d contract).
Oak Bluffs, Mass.
Arlington, Mass.

TOTAL SETS INSTALLED DURING YEAR, ... 43
TOTAL SETS INSTALLED TO DECEMBER 31, 1907, ... 677
TOTAL DAILY CAPACITY, TO DECEMBER 31, 1907, ... 545,865,000 cu. ft.

Tar Extractors for Carburetted Water Gas.
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Straight Standpipe System for Coal Gas Retorts.
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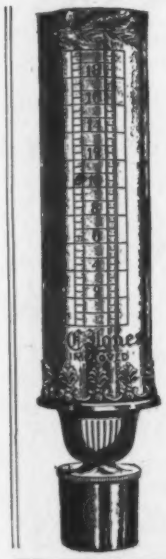

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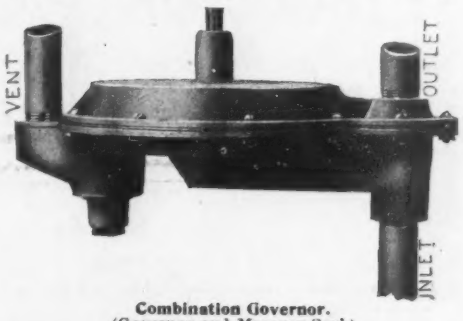

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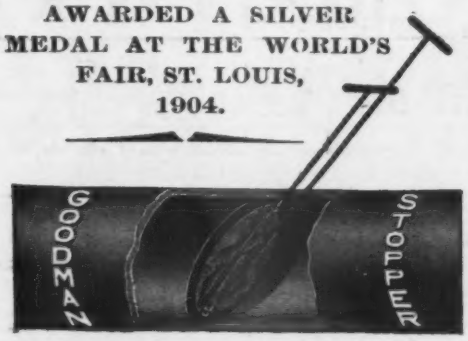

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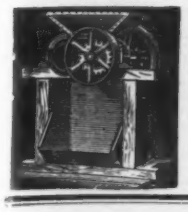

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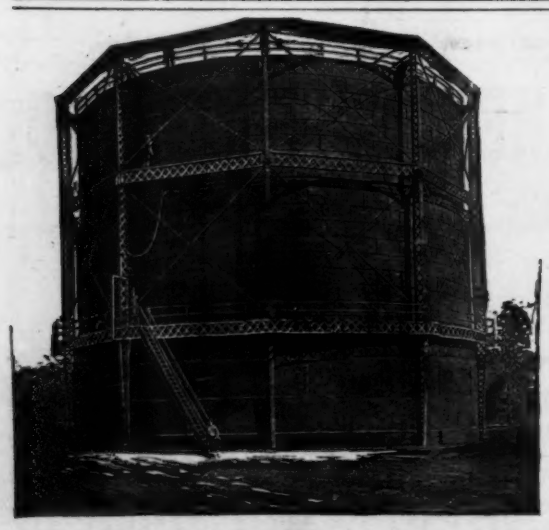

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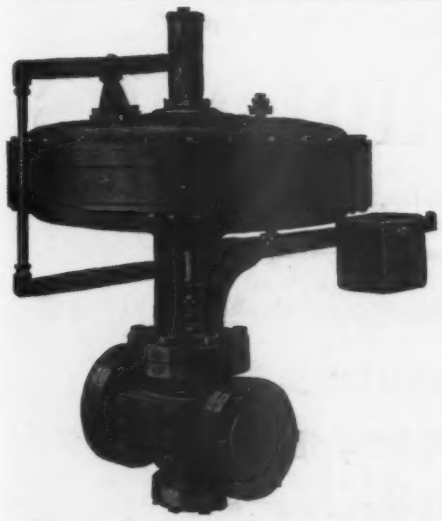

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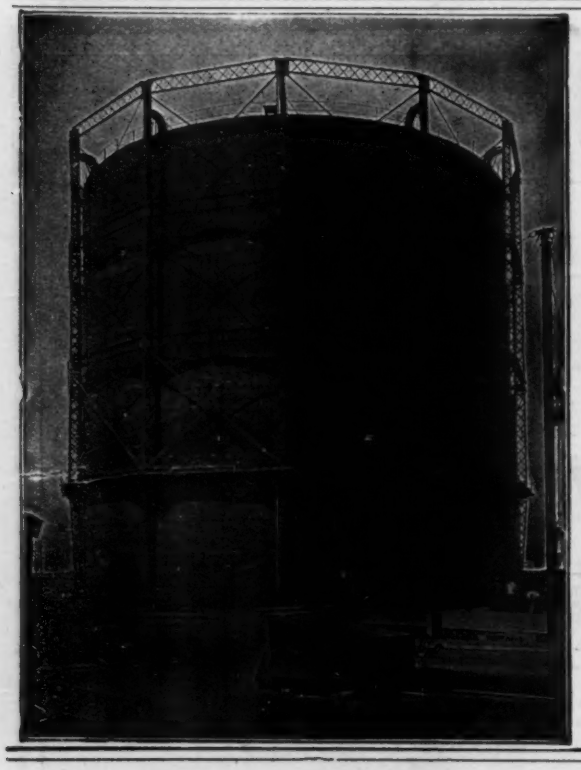

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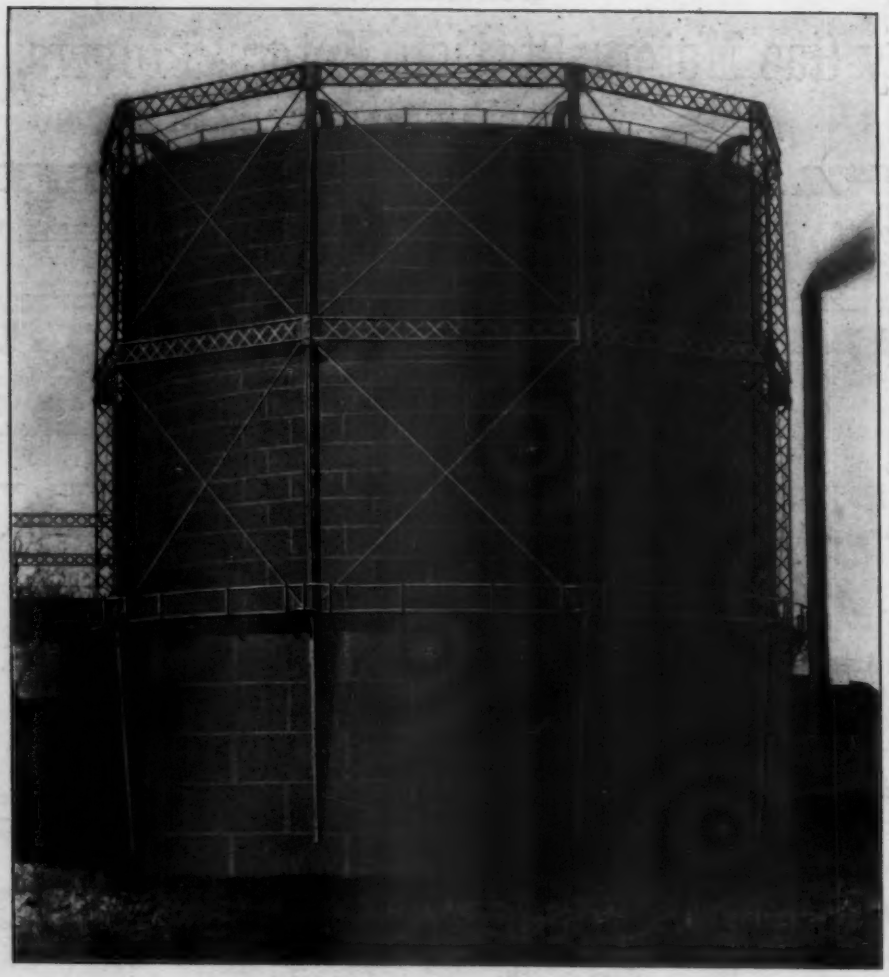

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